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1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

August 1990

COORDINATING RESEARCH COUNCIL, INC.
219 PERIMETER CENTER PARKWAY, ATLANTA, GEORGIA 30346

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1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

(CRC Project No. CM-123-89)

Prepared by the

1989 Analysis Panel

of the

CRC Octane Number Requirement Survey Group

August 1990

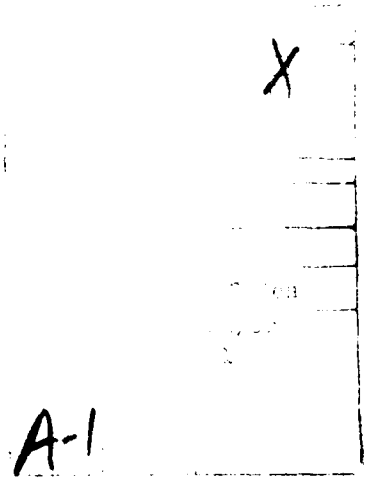
Automotive Vehicle Fuel, Lubricant, and Equipment Research Committee

of the

Coordinating Research Council, Inc.

ABSTRACT

An annual statistical survey of octane number requirements of current model vehicles is conducted by the Coordinating Research Council, Inc. Test data have been obtained by eighteen companies on 391 1989 vehicles including passenger cars and light-duty trucks and vans, of which 179 were equipped with knock sensors. Maximum octane number requirements were determined by testing at maximum-throttle conditions, as well as at part-throttle, with three unleaded fuel series of varying sensitivities. Requirements are expressed as the (R+M)/2 octane number, Research octane number, and Motor octane number of the reference fuel producing knock which was recurrent and repeatable at the lowest audible level. Estimated octane number requirements for the total vehicles are weighted in proportion to the 1989 vehicle model production and/or sales figures. The maximum octane number requirements of 1989 models with average sensitivity unleaded fuels were 85.1 (R+M)/2 octane numbers at the 50 percent satisfaction level, and 89.2 (R+M)/2 octane numbers at the 90 percent satisfaction level. Comparison with previous Surveys are made in this report.



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I. INTRODUCTION

This is the forty-third annual statistical survey of octane requirements of current model vehicles conducted by the Coordinating Research Council, Inc. This Survey studies distributions of vehicle octane requirements as a function of satisfaction levels and fuel sensitivity in a sample representative of 1989 model vehicles. Distributions of vehicle octane requirements are estimated from these data. The effect of fuel sensitivity, which is the difference between Research octane number (RON) and Motor octane number (MON), is investigated by using two full-boiling range fuel series and the primary reference fuel series. This is done because vehicles do not respond to RON and MON in the same way.

Knock sensors enable engines to adapt to fuels of varying octane numbers which can result in lowest audible knock occurring over a range of octane numbers. The high and low ends of this range are determined for each knock-sensor-equipped vehicle and the effect of these two octane requirements on the distribution is calculated.

The data in this Survey are obtained by trained raters under controlled conditions. For some vehicles, information on the owner's perception of vehicle knock and the owner's current choice of gasoline octane are available. A comparison between the trained rater's and customer's report of knock on tank fuel is presented, and trends are shown.

Eighteen companies participated in this Survey; they are listed in Appendix A. Members of the CRC Octane Number Requirement Survey Analysis Panel are identified in Appendix B.

II. SUMMARY

Octane number requirements were determined on 391 1989 model year vehicles, including 313 passenger cars and 78 light-duty trucks and vans. One hundred seventy-nine of the test vehicles were equipped with knock sensors. Estimated octane number requirements for the vehicle population are weighted in proportion to the 1989 vehicle model production and/or sales data. Maximum octane number requirements for the 1989 models and changes from 1988 for the four weighted vehicle population groups at the 50 percent and 90 percent levels using FBRU (full-boiling range unleaded) fuels are summarized below:

FBRU (R+M)/2 OCTANE NUMBER REQUIREMENTS AND 95% CONFIDENCE LEVELS

1989 AND CHANGES FROM 1988

Weighted Population	KS-H**	▲ from 1988	KS-L***	▲ from 1988
50% Satisfaction				
Total Vehicles (45.8%)*	85.1±0.3	0.4	84.9±0.3	0.9
Total Cars (42.8%)*	84.8±0.4	0.1	84.6±0.4	0.4
Total Trucks (57.7%)*	85.8±0.6	1.0	85.4±0.6	1.6
Total Knock-Sensor Vehicles	85.4±0.5	0.4	84.9±0.5	1.9
90% Satisfaction				
Total Vehicles	89.2±0.4	-0.1	88.7±0.4	0.1
Total Cars	89.2±0.5	0.0	88.8±0.5	0.1
Total Trucks	89.2±0.9	-0.4	88.7±0.8	0.1
Total Knock-Sensor Vehicles	89.7±0.7	-0.5	88.7±0.6	0.1

* Knock-sensor-equipped vehicles as percent of the associated population.

** KS-H = Population with knock sensor-equipped vehicles at maximum requirement.

*** KS-L = Population with knock-sensor-equipped vehicles at minimum-borderline requirement.

Maximum octane number requirements of the total 1989 vehicle population increased by 0.4 (R+M)/2 at 50 percent satisfaction and decreased by 0.1 (R+M)/2 at 90 percent satisfaction compared with 1988 on FBRU fuels. Maximum octane requirements of 1989 knock-sensor vehicles increased by 0.4 (R+M)/2 at 50 percent and decreased by 0.5 (R+M)/2 at 90 percent satisfaction compared with 1988.

The above data suggest the yearly difference in total vehicle satisfaction at the 50 percent level is significant and driven by changes in the total truck population. Changes in other distributions are not significant at the 95 percent confidence level.

Maximum and minimum-borderline octane number requirements were determined for knock-sensor-equipped vehicles. For the 1989 knock-sensor vehicle population, minimum-borderline octane number requirements were 0.5 (R+M)/2 lower than the maximum requirements at the 50 percent satisfaction level and 1.0 (R+M)/2 lower than the maximum requirements at the 90 percent level. Inclusion of the knock-sensor-equipped vehicles at their minimum-borderline requirement reduced the total vehicle population requirements by 0.2 (R+M)/2 at the 50 percent level and 0.5 (R+M)/2 at the 90 percent satisfaction levels relative to those calculated at their maximum requirements.

Part-throttle octane requirements were equal to or higher than the maximum-throttle octane requirements on 26 percent of all 1989 vehicles with FBRU fuels (97 of 379 vehicles). This compares with 31 percent of all 1988 vehicles with part-throttle requirement on FBRU fuels.

In the 1989 Survey, 30 percent of the vehicles tested knocked on tank fuel, which compares with 31 percent in the 1988 Survey.

The 1989 Survey included sufficient data for thirteen specific models to be analyzed separately as select models. All select models had automatic transmissions, and eight were equipped with knock sensors. Maximum octane requirements for the select models at the 50 percent and 90 percent satisfaction levels for FBRU fuels are summarized in the following table.

SELECT MODELS

MAXIMUM FBRU OCTANE NUMBER REQUIREMENTS

Select Model	No. Tested	(R+M)/2 50% Sat.	(R+M)/2 90% Sat.
C11BU2*P30A44 (Maximum)	10	86.5	89.5
C11BU2*P30A44 (Minimum-Borderline)	10	86.0	88.8
C21RC3*P22A4	11	82.7	86.8
C21S42*P38A4/C21S42*P38A4/C22S42*P38A4	23	86.9	89.7
C21PF2*P50A4/C22PF2*P50A4/C24PF2*P50A4	10	86.8	90.6
C31AR2*T25A3/C32AR2*T25A3/C33AR2*T25A3/C34AR2*T25A3/C34NR2*T25A3	11	86.2	89.9
C31AW2*P28A4/C32AW2*P28A4/C32WW2*P28A4/C33AW2*P28A4/C33WW2*P28A4/C34WW2*P28A4 (Maximum)	23	86.9	90.8
C31AW2*P28A4/C32AW2*P28A4/C32WW2*P28A4/C33AW2*P28A4/C33WW2*P28A4/C34WW2*P28A4 (Minimum-Borderline)	21	85.2	89.6
C31J12*T20A3/C31L12*T20A3	11	85.5	90.3
C32ND4*P23A3/C33ND4*P23A3/C34ND4*P23A3 (Maximum)	12	83.7	89.4
C32ND4*P23A3/C33ND4*P23A3/C34ND4*P23A3 (Minimum-Borderline)	11	82.2	86.8
C32WT2*P31A4/C33WT2*P31A4/C34WT2*P31A4 (Maximum)	11	85.5	90.3
C32WT2*P31A4/C33WT2*P31A4/C34WT2*P31A4 (Minimum-Borderline)	11	84.1	89.0
C33AN2*P33A4/C34AN2*P33A4 (Maximum)	12	87.6	92.2

SELECT MODELS -(Continued)

MAXIMUM FBRU OCTANE NUMBER REQUIREMENTS

Select Model	No. Tested	(R+M)/2 50% Sat.	(R+M)/2 90% Sat.
C33AN2*P33A4/C34AN2*P33A4 (Minimum-Borderline)	11	86.8	91.8
C32HC2*P38A4/C33EC2*P38A4/C33HC2*P38A4/C34HC2*P38A4/C34CC2*P38A4 (Maximum)	15	81.8	87.0
C32HC2*P38A4/C33EC2*P38A4/C33HC2*P38A4/C34HC2*P38A4/C34CC2*P38A4 (Minimum-Borderline)	14	80.5	85.5
S15XL2*P40A4 (Maximum)	10	85.1	91.2
S15XL2*P40A4 (Minimum-Borderline)	10	84.3	90.5
S36RK2*T57A4/V36GK2*T57A4/P36CK2*T57A4/S36UK2*T57A4/P36KK2*T57A4 (Maximum)	11	86.4	89.4
S36RK2*T57A4/V36GK2*T57A4/P36CK2*T57A4/S36UK2*T57A4/P36KK2*T57A4 (Minimum-Borderline)	10	85.6	88.4

III. TEST VEHICLES

This year's Survey tested a total of 391 1989 model vehicles, the same number as in the 1988 Survey. The analysis of the data included 313 passenger cars and 78 light-duty trucks and vans. Also included are 179 knock sensor-equipped vehicles (134 cars and 45 trucks).

Beginning with the 1987 Survey, test vehicles are divided into four main categories:

(1) Total Vehicles, which includes all US and imported passenger cars and light-duty trucks and vans

(2) Total Cars, which includes all US and imported passenger cars

(3) Total Trucks, which includes all US and imported light-duty trucks and vans

(4) Total Knock-Sensor Vehicles, which includes all knock-sensor-equipped US and imported passenger cars and light-duty trucks and vans.

In the 1989 Survey, 86 percent of the transmissions were automatic. Thirty-four percent of the automatics were three-speeds, and the rest four-speeds. The manual transmissions were divided into 5 percent four-speeds and 95 percent five-speeds. Ninety-seven percent of the surveyed vehicles were air-conditioned.

The select models shown in Table 1 include six additional models not included in the program proposal (Table D-1 of Appendix D). Although not appearing as select models in the program proposal, six of the models in Table 1 are included as select models because ten or more vehicles per model were tested.

Table 2 shows the distribution of odometer mileage for both the 1989 and 1988 Surveys. The 1989 distribution is shown as a bar chart in Figure 1. The average odometer mileage was 12,773. The average displacement of those vehicles tested in 1989 was 3.05 liters, compared with 3.01 in 1988. The average compression ratio of those vehicles tested in 1989 was 9.04 compared with 9.02 in 1988.

Trends in the sales-weighted average compression ratio, engine displacement, and knock-sensor penetration for the US vehicle population over the last five model years are shown below. Also included are the percent of vehicles tested in this Survey which have automatic transmissions and air conditioners.

1989 CNR SURVEY TEST VEHICLE DATA

Average Vehicle Parameters

Model Year	Sales Weighted Displacement (liters)	Sales Weighted Compression Ratio	Sales Weighted % Knock Sensor	Percent of Vehicles Tested Automatic Transmissions	Percent of Vehicles Tested Air Conditioners
1989	3.1	9.0	40.2	86	97
1988	3.0	9.0	39.6	82	92
1987	2.9	9.0	35.0	81	89
1986	3.0	9.0	35.5	84	94
1985	3.2	8.8	27.5	84	92

The basic spark timing was adjusted to the manufacturer's recommended setting (within ±1°) prior to testing. A total of ten vehicles were adjusted; eight were two or more degrees off from the manufacturer's setting. The number of vehicles and their deviation in spark setting are shown in Table 3.

Participants were requested to rate specific vehicle models in a pattern which would minimize data bias due to differences among testing laboratories and vehicles. To accomplish this, the United States and Canada were divided into four geographical areas, and companies within each geographical area were requested to test specific vehicles.

IV. REFERENCE FUELS

Three series of reference fuels were used in the 1989 Survey:

- Primary Reference (PR) Fuels
- Average Sensitivity Full-Boiling Range Unleaded (FBRU) Reference Fuels with sensitivities similar to those of commercial gasoline
- High-Sensitivity Full-Boiling Range Unleaded (FBRSU) Reference Fuels with sensitivities about two octane numbers higher than the FBRU fuels.

A. PR Fuels

Isooctane and normal heptane, meeting ASTM specifications, were blended in two octane number increments from 76 to 82 octane numbers, and in one octane number increments from 82 to 100 octane numbers.

B. FBRU Reference Fuels

FBRU fuels were prepared from three base blends (RMFD-368-89/90, RMFD-369-89/90, and RMFD-370-89/90) in two octane number increments from 80 to 84 RON, and in one octane number increments from 84 to 104 RON. The base blends were prepared from normal refinery components. Inspection data furnished by the supplier are shown in Appendix C, Table C-1. The composition and average laboratory octane data for the 1989/1990 FBRU reference fuel series are presented in Appendix C, Table C-2.

C. FBRSU Reference Fuels

FBRSU fuels were prepared from three base blends (RMFD-371-89/90 RMFD-372-89/90, and RMFD-373-89/90) in two octane number increments from 80 to 84 RON, and in one octane number increments from 84 to 103.5 RON. The base blends were prepared from normal refinery components. Inspection data furnished by the supplier are shown in Appendix C, Table C-3. The laboratory blending octane data for the 1989/1990 FBRSU reference fuels are presented in Table C-4.

V. TEST TECHNIQUE

The test technique (CRC Designation E-15-89, Attachment 2 of Appendix D) specified that octane number requirements be determined at level road acceleration conditions. The order of fuel testing was tank fuel, FBRSU fuels, FBRU fuels, and PR fuels. Knocking tendencies were investigated using both maximum-throttle and part-throttle acceleration techniques.* Part-throttle was investigated in each vehicle to determine if the part-throttle requirement was higher or equal to the maximum-throttle requirement with all three fuel series. Part-throttle requirements were also determined with FBRU fuels down to four Research octane numbers below the maximum requirement at maximum-throttle.

The maximum octane number requirement of a vehicle is defined as the octane number of the highest octane test fuel producing borderline knock. This requirement is defined at either maximum- or part-throttle acceleration conditions. For vehicles equipped with knock sensors, the technique also identifies the lowest octane fuel that gives borderline knock (minimum-borderline requirement). Requirements are expressed as the (R+M)/2 octane number, Research octane number (RON), and Motor octane number (MON) of the reference fuel which produces knock that is recurrent and repeatable at the lowest audible level.

Of the eighteen laboratories participating in the 1989 Survey, three used level roads and fifteen used chassis dynamometers. Seventy-two percent of the vehicles were tested on chassis dynamometers.

Average test temperature was 69°F, with a barometric pressure average of 29.75 inches Hg and average humidity of 58 grains per pound. Test conditions for individual observations are reported in Appendix E.

The table below shows the average test conditions and the average odometer readings for the last five Surveys.

Average Ambient Test Conditions

Year	Temperature, F°	Barometric Pressure, inches Hg	Humidity, grains per pound	Mileage
1989	69	29.75	58	12772
1988	70	29.84	57	12407
1987	67	29.85	49	13720
1986	70	29.83	58	11849
1985	69	29.91	57	12343

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* Maximum-throttle is either full-throttle for manual transmissions or widest throttle position (detent) that does not cause the transmission to downshift for automatic transmissions.

There is general agreement that ambient temperature, pressure, and humidity can influence the octane number requirement of a vehicle at any time.[1,2] Octane requirement increases as temperature and pressure increase, and as humidity decreases. The coefficients of these effects are difficult to determine and may be dependent upon the vehicle.

VI. DISCUSSION OF RESULTS

A. Distribution of Maximum Octane Number Requirements

The octane number requirement data were used to prepare satisfaction curves and tables for the following samples of 1989 model vehicles:

(1) Total Vehicles,
(2) Total Cars,
(3) Total Trucks,
(4) Total Knock-Sensor Vehicles.

Maximum (R+M)/2, RON, and MON requirements and 95 percent confidence limits for the four categories at 50 percent and 90 percent satisfaction are shown in Table 4. In preparing the curves and tables, the octane number requirement data were weighted in accordance with final 1989 model-year production and/or sales figures. Each curve and table, therefore, provides an estimate of the distribution of octane number requirements of the appropriate vehicle population on the road. The procedure for assigning weighting factors and for calculating the octane number requirement distributions is described in Appendix F.

Vehicles equipped with knock sensors were included in the 1989 models tested. All vehicles with knock sensors were tested for maximum octane number requirements, and 163 of the 179 vehicles were tested for minimum-borderline octane number requirements. Octane number requirement distributions were calculated for each group of vehicles using the requirements from those vehicles with knock sensors rated at maximum requirement and with their ratings at minimum-borderline requirement.

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(1) B. D. Keller, J. H. Steury, T. O. Wagner, SAE Paper 780668 (1978)

(2) H. A, Bigley, Jr., B. D. Keller and M. G. Kloppe, SAE Paper 710675 (1971).

Requirements are expressed as the (R+M)/2, Research, and Motor octane numbers of the reference fuel which produced knock that was recurrent and repeatable at the lowest audible level.

Round-off techniques were changed beginning with the 1988 Survey, and are described in Appendix F.

1. Total Vehicles

In the 1989 Survey, maximum octane number requirements were determined on 372 vehicles with PR fuels, and 391 vehicles with FBRU and FBRSU fuels. One hundred seventy-nine of the vehicles were equipped with knock sensors.

Maximum (R+M)/2 octane number requirements for all three reference fuels are shown in Figures 2, 3, and 4. Each plot compares two distributions of maximum octane requirements for total vehicles. One distribution includes knock-sensor vehicles at their maximum requirement; the other includes knock-sensor vehicles at their minimum-borderline requirement. The maximum (R+M)/2 octane number requirements for all three reference fuels are plotted in Figure 5. The octane number requirement distributions for FBRU and FBRSU fuels are similar. Maximum (R+M)/2, Research, and Motor octane number requirements are listed in Table 5. The 50 percent and 90 percent satisfaction level requirements are:

MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Vehicles)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	87.8	87.8	87.8	92.7	92.7	92.7
FBRU	85.1	89.0	81.3	89.2	94.0	84.5
FBRSU	85.1	90.1	80.1	89.3	95.2	83.4

Differences between 1989 and 1988 Survey maximum (R+M)/2, Research, and Motor octane number requirements are also shown in Tables 5 and 6 for all three fuel series. Distributions of the 1989 and 1988 maximum (R+M)/2 requirements are shown in Figure 6 for FBRU fuels. The differences at the 50 percent and 90 percent satisfaction levels are:

DIFFERENCES BETWEEN 1989 AND 1988 MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Vehicles)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	0.4	0.4	0.4	-0.2	-0.2	-0.2
FBRU	0.4	0.4	0.5	-0.1	-0.3	0.1
FBRSU	0.4	0.2	0.7	-0.5	-0.7	-0.3

Octane number requirements with knock-sensor-equipped vehicles tested at minimum-borderline level, along with differences between the 1989 and 1988 octane number requirments, are given in Table 6.

Confidence limits for maximum octane number requirement distributions are given in Appendix G, Table G-1. The 95 percent confidence limits for (R+M)/2 octane number requirements were ±0.3 to ±0.4 at the 50 percent satisfaction level, and ±0.4 to ±0.5 at the 90 percent satisfaction level. The yearly difference at the 50 percent satisfaction is significant at the 95 percent confidence level.

2. Total Cars

Maximum octane number requirements were determined on 298 cars with PR fuels, and 313 cars with FBRU and FBRSU fuels.

Maximum (R+M)/2, Research, and Motor octane number requirements on all three fuel series are given in Table 7. The maximum (R+M)/2 octane number requirement distributions for all three reference fuel series are plotted in Figure 7. Maximum octane number requirements at the 50 percent and 90 percent satisfaction levels are:

MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Cars)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	87.3	87.3	87.3	92.1	92.1	92.1
FBRU	84.8	88.5	81.0	89.2	94.0	84.5
FBRSU	84.8	89.7	79.8	89.5	95.4	83.6

Differences between the 1989 and 1988 Survey maximum (R+M)/2, Research and Motor octane number requirements are also shown in Table 7 for PR, FBRU, and FBRSU fuels. Distributions of the 1989 and 1988 maximum (R+M)/2 requirements are shown in Figure 8 for FBRU fuels. Differences between 1989 and 1988 data at the 50 percent and 90 percent satisfaction levels are:

DIFFERENCES BETWEEN 1989 AND 1988 MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Cars)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	0.2	0.2	0.2	-0.4	-0.4	-0.4
FBRU	0.1	-0.1	0.2	0.0	-0.2	0.2
FBRSU	0.3	0.0	0.5	-0.3	-0.5	-0.1

Octane number requirements with knock-sensor-equipped cars tested at minimum-borderline levels, along with differences between the 1989 and 1988 octane number requirments, are given in Table 8.

Confidence limits for maximum octane number requirement distributions of 1989 total cars are given in Appendix G, Table G-1. The 95 percent confidence limits for (R+M)/2 requirements were $\pm$0.4 at the 50 percent satisfaction level, and $\pm$0.5 at the 90 percent satisfaction level. The yearly changes for the total car population are not significant at the 95 percent confidence level.

3. Total Trucks

Maximum octane number requirements were determined on 74 light-duty trucks and vans with PR fuels, and 78 with FBRU and FBRSU fuels. Maximum (R+M)/2 octane number requirements for all three reference fuel series are plotted in Figure 9. Maximum (R+M)/2, Research, and Motor octane number requirements on all three fuel series are given in Table 9. The 50 percent and 90 percent satisfaction level maximum octane number requirements are:

MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Trucks)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	89.0	89.0	89.0	93.5	93.5	93.5
FBRU	85.8	89.8	81.8	89.2	94.0	84.5
FBRSU	85.6	90.7	80.4	89.1	94.9	83.2

Differences between the maximum (R+M)/2, Research, and Motor octane number requirements of trucks in the 1989 and 1988 Surveys are also given in Table 9 for all three fuel series. The differences at the 50 percent and 90 percent satisfaction levels are:

DIFFERENCES BETWEEN 1989 AND 1988 MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Trucks)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	1.0	1.0	1.0	-0.2	-0.2	-0.2
FBRU	1.0	1.1	0.9	-0.4	-0.6	-0.1
FBRSU	0.6	0.4	0.7	-0.7	-1.0	-0.5

Octane number requirements with knock-sensor-equipped trucks tested at minimum-borderline levels, along with the differences between the 1989 and 1988 octane number requirements, are given in Table 10. Distributions of the 1989 and 1988 maximum (R+M)/2 requirements are shown in Figure 10 for FBRU fuels.

Confidence limits for maximum octane number requirement distributions of 1989 trucks are tabulated in Appendix G, Table G-1. The 95 percent confidence limits for (R+M)/2 octane number requirements varied from $\pm$0.6 to $\pm$0.8 at the 50 percent satisfaction level, and from $\pm$0.9 to $\pm$1.1 at the 90 percent satisfaction level. The yearly difference at 50 percent satisfaction is significant at the 95 percent confidence level.

4. Total Knock-Sensor Vehicles

Maximum octane number requirements were determined on 171 vehicles containing knock sensors with PR fuels, and 179 vehicles with FBRU and FBRSU fuels. Minimum-borderline octane number requirements were determined on 107 vehicles, with PR fuels, 163 vehicles with FBRU fuels, and 114 vehicles with the FBRSU fuel series.

The distributions of maximum (R+M)/2 octane number requirements at the maximum and the minimum-borderline levels are shown in Figures 11 and 12, respectively, for the three fuel series. Maximum (R+M)/2, Research, and Motor octane number requirements for all three fuel series are given in Table 11. Maximum octane number requirements for the 50 percent and 90 percent satisfaction levels are:

MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Knock-Sensor Vehicles)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	88.3	88.3	88.3	93.7	93.7	93.7
FBRU	85.4	89.3	81.5	89.7	94.5	84.9
FBRSU	85.4	90.5	80.3	89.7	95.6	83.7

Differences between 1989 and 1988 Survey maximum (R+M)/2, Research, and Motor octane number requirements are also shown in Table 11. Distributions of maximum (R+M)/2 octane number requirements are shown in Figure 13 for FBRU fuels. The differences at the 50 percent and 90 percent satisfaction levels are:

DIFFERENCES BETWEEN 1989 AND 1988 MAXIMUM OCTANE NUMBER REQUIREMENTS

(Total Knock-Sensor Vehicles)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	0.4	0.4	0.4	0.3	0.3	0.3
FBRU	0.4	0.3	0.4	-0.5	-0.8	-0.2
FBRSU	0.2	-0.1	0.4	-0.6	-0.9	-0.4

Octane number requirements with knock-sensor-equipped vehicles tested at minimum-borderline levels, along with the differences between the 1989 and 1988 octane number requirements, are given in Table 12.

The differences between the maximum octane number requirements of 179 vehicles tested, and the octane number requirements at minimum-borderline levels of 163 vehicles are:

DIFFERENCES BETWEEN MAXIMUM AND MINIMUM OCTANE NUMBER REQUIREMENTS

(Total Knock-Sensor Vehicles)

	50% Satisfied			90% Satisfied		
Fuel	(R+M)/2	RON	MON	(R+M)/2	RON	MON
PR	1.1	1.1	1.1	1.9	1.9	1.9
FBRU	0.5	0.6	0.4	1.0	1.2	0.8
FBRSU	1.0	1.2	0.8	1.6	1.8	1.2

Confidence limits for maximum octane number requirement distributions of 1989 knock-sensor vehicles are given in Appendix G, Table G-1. The 95 percent confidence limits for maximum (R+M)/2 octane number requirements varied between $\pm$0.5 and $\pm$0.7 at the 50 percent satisfaction level, and between $\pm$0.7 and $\pm$0.9 at the 90 percent satisfaction level.

The 95 percent confidence limits for minimum-borderline (R+M)/2 octane number requirements varied between $\pm$0.5 and $\pm$0.8 at the 50 percent satisfaction level, and between $\pm$0.6 and $\pm$1.0 at the 90 percent satisfaction level. The yearly changes for the total knock-sensor vehicle population are not significant at the 95 percent confidence level.

B. Maximum Octane Number Requirement Trends

Trends over the last five years in the sales-weighted maximum octane number requirements of the four vehicle categories analyzed in this report are given below.

FBRU (R+M)/2 MAXIMUM OCTANE NUMBER REQUIREMENTS

1985 TO 1989

Weighted Population	1989	1988	1987	1986	1985
	50% Satisfaction				
Total Vehicles	85.1	84.7	85.7	85.3	86.4
Total Cars	84.8	84.7	85.4	85.0	86.2
Total Trucks	85.8	84.8	86.3	86.9*	--
Total Knock-Sensor Vehicles	85.4	85.0	86.6	85.4	86.7
	90% Satisfaction				
Total Vehicles	89.2	89.3	90.5	89.8	90.1
Total Cars	89.2	89.2	90.4	89.5	90.0
Total Trucks	89.2	89.6	91.6	90.3*	--
Total Knock-Sensor Vehicles	89.7	90.2	91.9	90.2	91.5

---

*The total trucks octane number requirements for 1986 were estimated from the percent satisfaction distributions for total vehicles and total cars

C. Part-Throttle Requirements

Part-throttle octane requirements were equal to or higher than the maximum-throttle octane requirements on 26 percent of all 1989 vehicles with FBRU fuels (97 of 379 vehicles). This compares with 31 percent in 1988.

D. Select Models

Select models, representing thirteen engine-transmission-chassis combinations, were tested. The select models tested in this year's Survey included eight knock-sensor-equipped models. The specifications of the engine-chassis combinations of the select models are in Table 1.

Maximum octane number requirements for each select model at various satisfaction levels are listed in Tables 13 through 25. The maximum and minimum-borderline octane number requirements for the eight knock-sensor-equipped models are given in Tables 13, 18, and 20 through 25.

E. Tank Fuel

Tank fuel was tested for incidence of knock on all vehicles. Owners' questionnaires, however, were obtained only when the vehicle tested had a regular driver and the spark timing was not reset.

1. Owner/Rater Comparisons of Tank Fuel Knock

For 124 vehicles, both owner and rater data were reported, and no adjustments of spark timing were made. The trained raters reported that 31 percent of the vehicles knocked, while the owners reported that 7 percent knocked, an owner/rater knock ratio of 0.24. The 31 percent of vehicles found to be knocking by trained raters compared with 39 percent for the 1988 Survey. These owner/rater comparisons of tank fuel knock for 1989, along with previous Survey data back to 1982, are presented in Table 26.

Tank fuel Research and Motor octane number data were reported for a total of 101 vehicles with both owner/rater data and no adjustments of spark timing. Sixty-eight vehicles were reported to have tank fuel octane numbers less than 91.0 (R+M)/2. Trained observers reported knock on 28 percent of these, compared with 4 percent for owners. Of the other 19 vehicles having tank fuels greater than or equal to 91.0 (R+M)/2, 11 percent knocked according to trained raters, while no owners reported knock.

2. Objectionable Versus Non-Objectionable Knock

Of the owners reporting tank-fuel knock with vehicles which had no change in spark timing, 10 percent found the knock to be objectionable, as compared to 4 percent in the 1988 Survey. Comparisons of objectionable knock for the 1982 through 1989 Surveys are also given in Table 26.

3. Tank Fuel Knock Reported by Trained Raters

Tank fuel knock observations were reported for 265 of the 391 vehicles tested. The percentages of all 1989 vehicles knocking on tank fuel are shown in Table 27. Knock was observed on 30 percent of the 1989 vehicles tested, compared with 31 percent in the 1988 Survey.

The percentages of select models knocking on tank fuel, also shown in Table 27 varied from a low of 0 percent to a high of 67 percent.

F. Engine Speed for Maximum Octane Number Requirements

Engine speeds at which maximum octane number requirements occurred for each select model are shown in Table 28 for PR, FBRU, and FBRSU fuels. Weighted data for all 1989 vehicles are shown in Table 29.

G. Gear Position for Maximum Octane Number Requirements

The throttle/gear position for maximum octane number requirements on FBRU fuels is shown in Table 30. Of the 391 vehicles tested, 336 (86 percent) were equipped with automatic transmissions and 55 (14 percent) were equipped with manual transmissions.

Maximum requirements at maximum-throttle occurred in 76 percent of the automatic transmission vehicles (13 percent in fourth gear, 39 percent in third gear, and 24 percent in second gear). Maximum requirements at part-throttle occurred in 24 percent of the automatic transmission vehicles (11 percent in fourth gear, 11 percent in third gear, and 2 percent in second gear).

For manual transmission vehicles, 63 percent had maximum requirements at maximum-throttle (37 percent in fourth gear, 24 percent in third gear, and 2 percent in second gear). Maximum requirements at part-throttle occurred in 37 percent of manual transmission vehicles (26 percent in fourth gear, and 11 percent in third gear). Fifth gear for five-speed manual transmissions was not examined per program instructions.

TABLES

and

FIGURES

TABLE 1

1989 SELECT MODEL SPECIFICATIONS

Model	Knock Sensor	Disp. (L)	Engine Type	Fuel System Type *	Comp. Ratio	Brake HP	Trans-mission
C11BU2*P30A44	KS	3.0	V6	MFI	9.3	150	A4
C21RC3*P22A4		2.2	L4	MFI	8.6	110	A4
C21D42*P38A4/C21S42*P38A4/C22S42*P38A4		3.8	V6	MFI	9.0	140	A4
C21PF2*P50A4/C22PF2*P50A4/C24PF2*P50A4		5.0	V8	MFI	8.9	150	A4
C31AR2*T25A3/C32AR2*T25A3/ C33AR2*T25A3		2.5	L4	TBI	8.3	98	A3
C31AW2*P28A4/C32AW2*P28A4/ C32WW2*P28A4	KS	2.8	V6	MFI	8.9	125	A4
C31J12*T20A3/C31L12*T20A3		2.0	L4	TBI	9.0	90	A3
C32ND4*P23A3/C33ND4*P233A3/ C34ND4*P23A3	KS	2.3	L4	MFI	9.5	150	A3
C32WT2*P31A4/C33WT2*P31A4/ C34WT2*P31A4	KS	3.1	V6	MFI	8.8	140	A4
C33AN2*P33A4/C34AN2*P33A4	KS	3.3	V6	MFI	9.0	160	A4
C32HC2*P38A4/C33EC2*P38A4/ C33HC2*P38A4/C34HC2*P38A4/ C34CC2*P38A4	KS	3.8	V6	MFI	8.5	165	A4
S15XL2*P40A4	KS	4.0	L6	MFI	8.8	177	A4
S36RK2*T57A4/V36GK2*T57A4/ P36CK2*T57A4	KS	5.7	V8	TBI	9.1	210	A4

* TBI = Throttle Body Fuel Injection;
Individual manufacturers may use different abbreviations.

TABLE 2

DISTRIBUTION OF ODOMETER MILEAGE

FOR TESTED VEHICLES

Mileage	No. of Vehicles Within Mileage Increments	
	1989 Vehicles	1988 Vehicles
0 - 1,999	0	0
2,000 - 3,999	0	0
4,000 - 5,999	0	4
6,000 - 7,999	85	80
8,000 - 9,999	72	79
10,000 - 11,999	51	73
12,000 - 13,999	35	35
14,000 - 15,999	47	30
16,000 - 17,999	39	29
18,000 - 19,999	20	24
20,000 - 24,999	29	27
25,000 - 29,999	11	4
30,000 +	2	6
No. of Vehicles	391	391
Average Mileage	12,773	12,407

TABLE 3

1989 BASIC SPARK TIMING ADJUSTMENTS

Degrees From Manufacturer's Setting	No. of Vehicles	
	+	-
1	0	2
2	1	3
3	1	1
4	0	0
5	1	0
6	0	0
7	1	0
8	0	0
9	0	0
10	0	0
11+	0	0
	4	6

Total vehicles adjusted	10
Total vehicles not adjusted	203
Total vehicles with timing not adjustable	178

TABLE 4

MAXIMUM OCTANE NUMBER REQUIREMENTS WITH 95% CONFIDENCE LIMITS

	Fuel	No. Vehicles	(R+M)/2 50% Sat.	(R+M)/2 90% Sat.	Research Octane No. 50% Sat.	Research Octane No. 90% Sat.	Motor Octane No. 50% Sat.	Motor Octane No. 90% Sat.
Total Vehicles	PR	372	87.8±0.4	92.7±0.5	87.8±0.4	92.7±0.5	87.8±0.4	92.7±0.5
	FBRU	391	85.1±0.3	89.2±0.4	89.0±0.4	94.0±0.5	81.3±0.3	84.5±0.3
	FBRSU	391	85.1±0.3	89.3±0.5	90.1±0.4	95.2±0.5	80.1±0.3	83.4±0.4
Total Cars	PR	298	87.3±0.4	92.1±0.5	87.3±0.4	92.1±0.5	87.3±0.4	92.1±0.5
	FBRU	313	84.8±0.4	89.2±0.5	88.5±0.5	94.0±0.6	81.0±0.3	84.5±0.4
	FBRSU	313	84.8±0.4	89.5±0.5	89.7±0.5	95.4±0.7	79.8±0.3	83.6±0.4
Total Trucks and Vans	PR	74	89.0±0.8	93.5±1.1	89.0±0.8	93.5±1.1	89.0±0.8	93.5±1.1
	FBRU	78	85.8±0.6	89.2±0.9	89.8±0.8	94.0±1.1	81.8±0.5	84.5±0.7
	FBRSU	78	85.6±0.7	89.1±0.9	90.7±0.8	94.9±1.1	80.4±0.5	83.2±0.7
Total Knock-Sensor Vehicles	PR	171	88.3±0.7	93.7±0.9	88.3±0.7	93.7±0.9	88.3±0.7	93.7±0.9
	FBRU	179	85.4±0.5	89.7±0.7	89.3±0.6	94.5±0.9	81.5±0.4	84.9±0.5
	FBRSU	179	85.4±0.5	89.7±0.7	90.5±0.6	95.6±0.8	80.3±0.4	83.7±0.5

TABLE 5

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL VEHICLES

[For Knock-Sensor Vehicles, Maximum Octane Number Requirements Are Used]

	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
Percent Satisfied	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	83.4	1.9	81.0	1.1	83.9	1.0	78.0	1.1	80.8	1.0	85.1	1.0	76.6	1.0
20	84.8	0.9	82.5	0.7	85.7	0.6	79.2	0.7	82.2	0.7	86.7	0.5	77.7	0.9
30	85.9	0.6	83.4	0.4	86.9	0.3	80.0	0.6	83.1	0.5	87.8	0.3	78.5	0.8
40	86.9	0.5	84.3	0.4	87.9	0.2	80.6	0.4	84.0	0.3	88.8	0.1	79.2	0.6
50	87.8	0.4	85.1	0.4	89.0	0.4	81.3	0.5	85.1	0.4	90.1	0.2	80.1	0.7
60	88.8	0.4	85.9	0.2	90.0	0.2	81.9	0.3	85.9	0.3	91.2	0.2	80.7	0.5
70	89.9	0.4	86.9	0.1	91.1	-0.1	82.7	0.3	86.8	0.1	92.2	-0.1	81.3	0.2
80	90.9	-0.2	87.9	-0.1	92.3	-0.3	83.5	0.2	87.9	-0.1	93.6	-0.2	82.3	0.2
90	92.7	-0.2	89.2	-0.1	94.0	-0.3	84.5	0.1	89.3	-0.5	95.2	-0.7	83.4	-0.3
95	94.1	0.2	90.5	-0.1	95.4	-0.3	85.5	0.1	90.7	-0.3	96.8	-0.5	84.6	-0.2
98	95.8	0.2	92.9	0.9	98.3	0.8	87.5	0.9	93.0	0.5	99.4	0.6	86.7	0.6
99	97.1	0.5	93.8	0.9	99.3	0.8	88.3	1.0	93.9	-0.7	100.4	-0.7	87.5	-0.6

TABLE 6

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL VEHICLES

[For Knock-Sensor Vehicles, Minimum-Borderline Octane Number Requirements Are Used]

	PR Fuels		FBRU Fuels						FBRSU					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
Percent Satisfied	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	82.8	1.9	80.1	0.6	82.9	0.5	77.3	0.8	80.2	0.9	84.4	0.9	76.1	1.0
20	84.4	1.0	82.2	0.8	85.4	0.8	79.0	0.9	81.7	0.7	86.2	0.6	77.3	0.9
30	85.5	0.9	83.2	0.8	86.7	0.8	79.8	0.8	82.8	0.8	87.4	0.6	78.2	0.9
40	86.5	0.9	84.1	0.8	87.7	0.8	80.5	0.8	83.7	0.8	88.4	0.5	78.9	0.9
50	87.4	0.7	84.9	0.9	88.7	0.9	81.1	0.8	84.6	0.8	89.5	0.6	79.7	1.0
60	88.4	0.8	85.7	0.7	89.7	0.8	81.7	0.7	85.6	0.8	90.8	0.7	80.5	0.9
70	89.6	0.9	86.5	0.5	90.7	0.5	82.4	0.6	86.4	0.5	91.8	0.4	81.1	0.7
80	90.6	0.6	87.5	0.2	91.8	0.0	83.2	0.4	87.2	0.0	92.7	-0.2	81.7	0.3
90	91.9	-0.3	88.7	0.1	93.3	-0.1	84.1	0.2	88.9	-0.3	94.7	-0.5	83.1	-0.1
95	93.0	-0.5	90.0	0.1	94.9	0.0	85.1	0.3	90.1	-0.2	96.1	-0.4	84.1	-0.1
98	94.8	-0.1	91.7	0.5	96.9	0.4	86.6	0.7	91.9	0.1	98.1	0.0	85.6	0.1
99	96.2	-0.2	92.9	0.8	98.3	0.7	87.5	0.9	93.2	-0.3	99.6	-0.4	86.8	-0.3

TABLE 7

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL CARS

[For Knock-Sensor Vehicles, Maximum Octane Number Requirements Are Used]

Percent Satisfied	PR Fuels		FBRU Fuels						FBRSU					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
	1989	Diff. 1988	1989	Diff 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	83.1	2.2	80.3	0.9	83.2	0.9	77.5	1.0	80.4	1.0	84.6	0.9	76.3	1.1
20	84.5	1.1	82.2	0.8	85.4	0.7	79.0	0.8	82.0	0.9	86.5	0.8	77.5	1.0
30	85.6	0.8	83.1	0.3	86.5	0.1	79.7	0.4	82.9	0.5	87.5	0.3	78.3	0.8
40	86.5	0.6	84.0	0.2	87.5	0.0	80.4	0.3	83.7	0.2	88.5	-0.1	78.9	0.4
50	87.3	0.2	84.8	0.1	88.5	-0.1	81.0	0.2	84.8	0.3	89.7	0.0	79.8	0.5
60	88.2	0.1	85.6	0.0	89.6	-0.1	81.6	0.1	85.8	0.4	90.9	0.1	80.6	0.6
70	89.2	-0.1	86.5	-0.3	90.6	-0.6	82.3	-0.1	86.5	-0.3	91.9	-0.5	81.1	-0.1
80	90.3	-0.6	87.6	-0.4	92.0	-0.6	83.3	-0.1	87.6	-0.7	93.2	-1.0	82.0	-0.3
90	92.1	-0.4	89.2	0.0	94.0	-0.2	84.5	0.2	89.5	-0.3	95.4	-0.5	83.6	-0.1
95	93.7	0.3	91.1	0.9	96.1	0.8	86.0	0.9	91.4	0.6	97.7	0.7	85.2	0.7
98	95.6	1.0	93.2	1.6	98.7	1.7	87.8	1.5	93.4	1.0	99.9	1.1	87.0	1.0
99	96.8	0.6	94.0	0.2	99.5	0.1	88.4	0.2	94.2	-0.6	100.8	-0.5	87.7	-0.6

TABLE 8

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL CARS

[For Knock-Sensor Vehicles, Minimum-Borderline Octane Number Requirements Are Used]

Percent Satisfied	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	83.0	2.7	79.6	0.7	82.3	0.7	76.9	0.8	80.1	1.4	84.2	1.3	76.0	1.4
20	84.3	1.4	81.9	0.9	85.1	0.9	78.8	0.9	81.6	0.9	86.1	1.0	77.2	1.0
30	85.2	0.8	82.9	0.4	86.2	0.2	79.5	0.5	82.7	0.7	87.3	0.5	78.1	0.8
40	86.2	0.6	83.8	0.4	87.3	0.2	80.2	0.4	83.4	0.3	88.2	0.1	78.7	0.6
50	87.0	0.3	84.6	0.4	88.3	0.3	80.9	0.5	84.4	0.3	89.3	0.1	79.5	0.5
60	87.9	0.3	85.5	0.3	89.4	0.2	81.5	0.3	85.4	0.4	90.5	0.2	80.3	0.6
70	89.0	0.3	86.2	-0.1	90.3	-0.2	82.1	0.1	86.2	0.0	91.5	-0.3	80.9	0.2
80	90.1	0.0	87.2	-0.3	91.5	-0.5	82.9	0.0	87.2	-0.3	92.7	-0.6	81.7	0.0
90	91.4	-0.7	88.8	0.1	93.4	0.0	84.2	0.3	89.1	-0.3	95.0	-0.4	83.3	0.0
95	93.2	0.2	90.3	0.3	95.3	0.3	85.4	0.5	90.3	-0.1	96.3	-0.3	84.2	0.0
98	94.7	0.3	91.8	0.5	96.9	0.3	86.6	0.6	92.4	0.1	98.7	0.1	86.0	0.1
99	95.5	-0.2	93.0	0.0	98.4	-0.1	87.6	0.2	93.8	-0.9	100.3	-0.9	87.3	-0.8

TABLE 9

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL TRUCKS AND VANS

[For Knock-Sensor Vehicles, Maximum Octane Number Requirements Are Used]

	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
Percent Satisfied	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	84.0	1.3	81.7	0.8	84.8	0.7	78.6	0.8	81.3	0.4	85.7	0.2	77.0	0.6
20	85.5	0.5	83.1	0.9	86.6	1.0	79.7	0.9	82.8	0.7	87.4	0.6	78.2	0.9
30	87.0	1.0	84.1	0.6	87.8	0.6	80.5	0.7	83.7	0.7	88.5	0.5	78.9	0.8
40	88.0	0.8	85.0	0.9	88.8	0.9	81.2	0.9	84.7	0.8	89.6	0.6	79.7	0.9
50	89.0	1.0	85.8	1.0	89.8	1.1	81.8	0.9	85.6	0.6	90.7	0.4	80.4	0.7
60	90.2	1.3	86.7	0.8	90.9	0.8	82.5	0.8	86.4	0.6	91.7	0.5	81.0	0.6
70	90.1	0.9	87.5	0.7	91.8	0.6	83.1	0.7	87.4	0.8	92.9	0.8	81.8	0.8
80	92.0	0.4	89.3	0.4	92.8	0.3	83.8	0.5	88.2	0.8	93.9	0.7	82.5	0.9
90	93.5	-0.2	89.2	-0.4	94.0	-0.6	84.5	-0.1	89.1	-0.7	94.9	-1.0	83.2	-0.5
95	94.5	-0.6	89.8	-1.6	94.6	-2.1	84.9	-1.2	90.0	-1.4	96.0	-1.7	84.0	-1.1
98	96.0	-0.3	91.4	-0.8	96.5	-1.2	86.3	-0.4	91.7	-1.4	98.0	-1.5	85.5	-1.2
99	****	****	93.1	****	98.5	****	87.7	****	92.9	-1.4	99.2	-1.6	86.5	-1.3

**** Insufficient data for numerical assignment

TABLE 10

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL TRUCKS AND VANS

[For Knock-Sensor Vehicles, Minimum Borderline Octane Number Requirements Are Used]

Percent Satisfied	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	82.1	-0.1	81.4	0.6	84.4	0.5	78.4	0.8	80.4	-0.2	84.5	-0.6	76.2	0.1
20	84.8	0.7	83.0	1.3	86.3	1.2	79.6	1.2	82.1	0.7	86.5	0.5	77.6	0.9
30	86.4	1.5	84.0	1.6	87.6	1.8	80.4	1.5	83.3	1.3	88.0	1.2	78.6	1.3
40	87.5	1.8	84.7	1.6	88.5	1.8	81.0	1.5	84.1	1.4	88.9	1.3	79.3	1.5
50	88.5	1.8	85.4	1.6	89.3	1.8	81.5	1.5	85.2	1.8	90.2	1.8	80.1	1.7
60	90.1	2.4	86.2	1.7	90.3	2.0	82.1	1.5	86.1	1.7	91.4	1.9	80.8	1.6
70	90.8	2.1	87.1	1.7	91.4	1.9	82.8	1.4	86.7	1.3	92.1	1.4	81.3	1.3
80	91.4	1.5	87.8	0.9	92.2	0.9	83.4	0.9	87.3	0.7	92.8	0.6	81.7	0.7
90	92.2	-0.9	88.7	0.1	93.3	0.1	84.1	0.3	88.4	0.4	94.1	0.2	82.7	0.6
95	92.8	-1.4	89.4	-0.4	94.2	-0.5	84.6	-0.1	89.7	-0.3	95.6	-0.5	83.7	-0.2
98	96.0	0.2	90.8	-0.2	95.9	-0.4	85.8	0.0	91.2	-0.1	97.4	-0.2	85.0	0.0
99	****	****	93.0	****	98.4	****	87.6	****	92.3	****	98.6	****	86.0	****

**** Insufficient data for numerical assignment

TABLE 11

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL KNOCK-SENSOR VEHICLES

[For Knock-Sensor Vehicles, Maximum Octane Number Requirements Are Used]

	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
Percent Satisfied	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	82.6	2.5	79.9	1.0	82.6	1.0	77.1	1.0	80.2	0.9	84.3	0.8	76.1	1.0
20	84.9	1.8	82.3	1.0	85.6	1.1	79.1	1.1	82.1	0.9	86.6	0.8	77.7	1.1
30	86.1	1.4	83.6	0.8	87.2	0.9	80.1	0.9	83.4	0.9	88.2	0.9	78.7	1.1
40	87.2	0.8	84.6	0.5	88.3	0.4	80.9	0.6	84.4	0.4	89.3	0.2	79.5	0.6
50	88.3	0.4	85.4	0.4	89.3	0.1	81.5	0.4	85.4	0.2	90.5	-0.1	80.3	0.4
60	89.4	0.3	86.3	0.0	90.5	0.0	82.2	0.2	86.3	0.1	91.6	-0.1	80.9	0.2
70	90.5	0.2	87.6	-0.1	91.9	-0.4	83.3	0.2	87.5	0.2	93.1	0.0	82.0	0.4
80	91.8	-0.4	88.5	-0.3	93.1	-0.6	84.0	0.0	88.4	-0.4	94.2	-0.6	82.7	-0.1
90	93.7	0.3	89.7	-0.5	94.5	-0.8	84.9	-0.2	89.7	-0.6	95.6	-0.9	83.7	-0.4
95	94.8	0.7	91.8	0.4	97.0	0.3	86.6	0.5	92.0	0.6	98.2	0.5	85.7	0.6
98	96.6	1.2	93.5	1.2	98.9	1.1	88.0	1.2	93.5	0.4	99.9	0.4	87.0	0.4
99	****	****	94.4	1.7	100.0	1.7	88.8	1.7	94.0	****	100.5	****	87.5	****

**** Insufficient data for numerical assignment

TABLE 12

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 TOTAL KNOCK-SENSOR VEHICLES

[For Knock-Sensor Vehicles, Minimum Borderline Octane Number Requirements Are Used]

	PR Fuels		FBRU Fuels						FBRSU Fuels					
			(R+M)/2		RON		MON		(R+M)/2		RON		MON	
Percent Satisfied	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988	1989	Diff. 1988
10	80.4	3.4	78.7	*****	81.2	*****	76.1	*****	79.3	1.5	83.2	1.5	75.4	1.6
20	83.3	1.8	81.3	1.2	84.4	1.2	78.3	1.2	80.4	0.2	84.6	0.1	76.3	0.5
30	84.9	1.6	82.8	1.2	86.2	1.3	79.5	1.2	82.1	1.0	86.6	0.9	77.6	1.1
40	86.1	1.8	84.1	1.7	87.7	1.9	80.5	1.6	83.5	1.6	88.2	1.6	78.7	1.6
50	87.2	2.1	84.9	1.9	88.7	2.1	81.1	1.7	84.4	1.7	89.3	1.7	79.5	1.7
60	88.4	2.1	85.6	1.8	89.5	2.0	81.6	1.6	85.3	1.7	90.4	1.8	80.3	1.8
70	90.1	2.5	86.4	1.5	90.6	1.7	82.3	1.3	86.2	1.2	91.5	1.2	80.9	1.2
80	90.8	1.5	87.6	1.0	92.0	1.1	83.3	1.1	87.0	0.5	92.5	0.4	81.5	0.6
90	91.8	-0.4	88.7	0.1	93.3	-0.1	84.1	0.3	88.1	-0.4	93.8	-0.6	82.5	0.0
95	92.9	-0.3	90.2	0.1	95.1	0.0	85.3	0.3	90.1	0.5	96.2	0.6	84.1	0.6
98	94.6	0.6	91.4	0.5	96.5	0.4	86.3	0.7	91.3	0.4	97.4	0.2	85.1	0.5
99	95.8	****	92.4	0.9	97.6	0.8	87.1	1.0	92.3	0.4	98.6	0.3	86.0	0.4

**** Insufficient data for numerical assignment

TABLE 13

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: C11BU2*P30A4

Percent Satisfied	PRC*	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	83.2	86.1	79.4	82.8	87.9	78.6	83.2
10	84.4	87.1	80.1	83.6	88.8	79.1	84.0
20	85.8	88.4	80.9	84.6	89.9	79.9	84.9
30	86.8	89.2	81.5	85.3	90.6	80.4	85.5
40	87.7	90.0	81.9	86.0	91.3	80.8	86.0
50	88.5	90.7	82.4	86.5	91.9	81.2	86.6
60	89.3	91.4	82.9	87.1	92.5	81.6	87.1
70	90.2	92.2	83.3	87.8	93.2	82.0	87.6
80	91.2	93.0	83.9	88.5	93.9	82.6	88.2
90	92.6	94.3	84.7	89.5	95.0	83.3	89.1
95	93.8	95.3	85.4	90.3	95.9	83.9	89.9
N	10	10	10	10	10	10	10
Mean	88.5	90.7	82.4	86.5	91.9	81.2	86.6
Estimated Std. Dev. of the Sample Population	3.2	2.8	1.8	2.3	2.4	1.6	2.0

TABLE 13 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum-Borderline
SELECT MODEL: C11BU2*P30A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	82.8	85.8	79.2	82.5	86.9	77.9	82.4
10	84.0	86.8	79.9	83.3	87.8	78.4	83.1
20	85.5	87.9	80.6	84.3	88.8	79.2	84.0
30	86.6	88.7	81.1	84.9	89.6	79.7	84.6
40	87.5	89.4	81.6	85.5	90.3	80.1	85.2
50	88.4	90.1	82.0	86.0	90.9	80.5	85.7
60	89.2	90.8	82.4	86.6	91.5	80.9	86.2
70	90.2	91.5	82.9	87.2	92.1	81.4	86.8
80	91.2	92.3	83.4	87.8	92.9	81.9	87.4
90	92.7	93.4	84.1	88.8	94.0	82.6	88.3
95	94.0	94.4	84.8	89.6	94.9	83.2	89.0
N	8	10	10	10	8	8	8
Mean	88.4	90.1	82.0	86.0	90.9	80.5	85.7
Estimated Std. Dev. of the Sample Population	3.4	2.6	1.7	2.1	2.4	1.6	2.0

TABLE 14

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

SELECT MODEL: C21RC3*P22A4

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	80.5	79.7	75.2	77.5	80.6	73.7	77.1
10	81.6	81.1	76.1	78.6	82.0	74.6	78.3
20	82.9	82.8	77.2	80.0	83.6	75.7	79.7
30	83.9	84.0	78.0	81.0	84.8	76.5	80.7
40	84.7	85.1	78.7	81.9	85.9	77.2	81.5
50	85.4	86.0	79.4	82.7	86.8	77.8	82.3
60	86.2	87.0	80.0	83.5	87.8	78.4	83.1
70	87.0	88.1	80.7	84.4	88.8	79.1	83.9
80	88.0	89.3	81.5	85.4	90.0	79.9	84.9
90	89.3	91.0	82.6	86.8	91.7	81.0	86.3
95	90.4	92.4	83.5	87.9	93.0	81.9	87.5
N	10	11	11	11	11	11	11
Mean	85.4	86.0	79.4	82.7	86.8	77.8	82.3
Estimated Std. Dev. of the Sample Population	3.0	3.8	2.5	3.2	3.8	2.5	3.1

TABLE 15

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

SELECT MODEL: C21D42*P38A4/C21S42*P38A4/C22S42*P38A4

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	85.4	86.8	79.9	83.3	87.7	78.3	83.0
10	86.5	87.7	80.5	84.1	88.7	79.0	83.9
20	87.7	88.9	81.2	85.1	90.0	79.9	84.9
30	88.6	89.7	81.8	85.7	90.9	80.5	85.7
40	89.4	90.4	82.2	86.3	91.6	81.0	86.3
50	90.1	91.1	82.7	86.9	92.3	81.5	86.9
60	90.9	91.8	83.1	87.4	93.1	82.0	87.5
70	91.6	92.5	83.6	88.0	93.8	82.5	88.2
80	92.5	93.3	84.1	88.7	94.7	83.1	88.9
90	93.8	94.5	84.9	89.7	96.0	84.0	90.0
95	94.8	95.4	85.5	90.4	97.0	84.7	90.8
N	23	23	23	23	23	23	23
Mean	90.1	91.1	82.7	86.9	92.3	81.5	86.9
Estimated Std. Dev. of of the Sample Population	2.8	2.6	1.7	2.2	2.8	1.9	2.4

TABLE 16

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

SELECT MODEL: C21PF2*P50A4/C22PF2*P50A4/C24PF2*P50A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	85.2	85.1	78.7	81.9	85.1	76.5	80.8
10	86.2	86.4	79.6	83.0	86.5	77.5	82.0
20	87.5	88.0	80.6	84.3	88.2	78.7	83.4
30	88.4	89.1	81.4	85.3	89.4	79.5	84.4
40	89.1	90.1	82.0	86.1	90.4	80.2	85.3
50	89.8	91.0	82.6	86.8	91.3	80.9	86.1
60	90.6	91.9	83.2	87.6	92.3	81.5	86.9
70	91.3	92.9	83.9	88.4	93.3	82.3	87.8
80	92.2	94.0	84.6	89.3	94.5	83.1	88.8
90	93.5	95.6	85.6	90.6	96.2	84.3	90.2
95	94.5	96.9	86.5	91.7	97.6	85.2	91.4
N	10	10	10	10	10	10	10
Mean	89.8	91.0	82.6	86.8	91.3	80.9	86.1
Estimated Std. Dev. of of the Sample Population	2.8	3.6	2.4	3.0	3.8	2.6	3.2

TABLE 17

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

SELECT MODEL: C31AR2*T25A3/C32AR2*T25A3/C33AR2*T25A3/
C34AR2*T25A3/C34NR2*T25A3

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	81.5	84.6	78.4	81.5	86.0	77.2	81.6
10	82.4	85.9	79.3	82.6	87.3	78.1	82.7
20	83.5	87.4	80.3	83.8	88.9	79.2	84.1
30	84.3	88.5	81.0	84.7	90.1	80.0	85.0
40	85.0	89.4	81.6	85.5	91.1	80.7	85.9
50	85.6	90.3	82.2	86.2	92.0	81.3	86.6
60	86.2	91.2	82.7	87.0	92.9	81.9	87.4
70	86.9	92.1	83.4	87.7	93.9	82.6	88.3
80	87.7	93.2	84.1	88.7	95.1	83.4	89.2
90	88.8	94.8	85.1	89.9	96.7	84.5	90.6
95	89.7	96.0	85.9	91.0	98.0	85.4	91.7
N	11	11	11	11	11	11	11
Mean	85.6	90.3	82.2	86.2	92.0	81.3	86.6
Estimated Std. Dev. of the Sample Population	2.5	3.5	2.3	2.9	3.6	2.5	3.1

TABLE 18

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum

SELECT MODEL: C31AW2*P284A/C32AW2*P28A4/C32WW2*P28A4/
C33AW2*P28A4/C33WW2*P28A4/C34WW2*P28A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	83.6	85.1	78.7	81.9	86.7	77.7	82.2
10	84.6	86.4	79.6	83.0	88.0	78.6	83.3
20	85.8	88.0	80.7	84.3	89.6	79.7	84.6
30	86.7	89.2	81.4	85.3	90.8	80.4	85.6
40	87.4	90.2	82.1	86.1	91.7	81.1	86.4
50	88.2	91.1	82.7	86.9	92.7	81.7	87.2
60	88.9	92.0	83.3	87.6	93.6	82.4	88.0
70	89.6	93.0	83.9	88.5	94.5	83.0	88.8
80	90.5	94.2	84.7	89.4	95.7	83.8	89.8
90	91.7	95.8	85.7	90.8	97.3	84.9	91.1
95	92.7	97.1	86.6	91.9	98.6	85.8	92.2
N	23	23	23	23	23	23	23
Mean	88.2	91.1	82.7	86.9	92.7	81.7	87.2
Estimated Std. Dev. of the Sample Population	2.8	3.7	2.4	3.0	3.6	2.5	3.0

TABLE 18 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock-Sensor Select Model - Minimum Borderline

SELECT MODEL: C31AW2*P28A4/C32AW2*P28A4/C32WW2*P28A4/
C33AW2*P28A4/C33WW2*P28A4/C34WW2*P28A4

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	82.1	82.2	76.8	79.5	84.5	76.2	80.3
10	83.1	83.7	77.8	80.8	85.9	77.2	81.6
20	84.4	85.5	79.0	82.3	87.7	78.4	83.1
30	85.3	86.8	79.9	83.4	89.0	79.3	84.2
40	86.1	88.0	80.6	84.3	90.1	80.1	85.1
50	86.8	89.0	81.3	85.2	91.2	80.7	86.0
60	87.5	90.1	82.0	86.0	92.2	81.4	86.8
70	88.3	91.2	82.7	87.0	93.3	82.2	87.8
80	89.2	92.5	83.6	88.1	94.6	83.1	88.8
90	90.5	94.4	84.8	89.6	96.4	84.3	90.3
95	91.6	95.9	85.8	90.8	97.9	85.3	91.6
N	14	21	21	21	14	14	14
Mean	86.8	89.0	81.3	85.2	91.2	80.7	86.0
Estimated Std. Dev. of the Sample Population	2.9	4.2	2.7	3.4	4.1	2.7	3.4

TABLE 19

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

SELECT MODEL: C31J12*T20A3/C31L12*T20A3

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	80.3	81.8	76.6	79.2	82.7	74.9	78.8
10	81.7	83.5	77.7	80.6	84.5	76.1	80.3
20	83.5	85.5	79.0	82.3	86.7	77.7	82.2
30	84.8	87.0	80.0	83.5	88.3	78.8	83.6
40	85.9	88.2	80.8	84.5	89.7	79.7	84.7
50	86.9	89.4	81.5	85.5	91.0	80.6	85.8
60	88.0	90.5	82.3	86.4	92.2	81.5	86.9
70	89.1	91.8	83.1	87.4	93.6	82.5	88.0
80	90.4	93.2	84.1	88.6	95.2	83.6	89.4
90	92.2	95.2	85.4	90.3	97.4	85.1	91.2
95	93.6	96.9	86.5	91.7	99.2	86.4	92.8
N	10	11	11	11	11	11	11
Mean	86.9	89.4	81.5	85.5	91.0	80.6	85.8
Estimated Std. Dev. of the Sample Population	4.1	4.6	3.0	3.8	5.0	3.5	4.3

TABLE 20

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: C32ND4*P23A3/C33ND4*P23A3/C34ND4*P23A3

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	75.2	78.6	74.3	76.5	78.6	72.2	75.4
10	77.4	80.5	75.6	78.1	80.9	73.7	77.3
20	80.1	82.9	77.2	80.0	83.6	75.6	79 6
30	82.0	84.6	78.3	81.4	85.5	76.9	81.2
40	83.7	86.0	79.3	82.6	87.2	78.0	82.6
50	85.2	87.3	80.2	83.7	88.7	79.1	83.9
60	86.8	88.7	81.1	84.9	90.3	80.1	85.2
70	88.5	90.1	82.0	86.1	92.0	81.3	86.6
80	90.4	91.8	83.2	87.5	93.9	82.6	88.3
90	93.1	94.1	84.7	89.4	96.6	84.4	90.5
95	95.3	96.1	86.0	91.0	98.9	86.0	92.4
N	12	12	12	12	12	12	12
Mean	85.2	87.3	80.2	83.7	88.7	79.1	83.9
Estimated Std. Dev. of the Sample Population	6.1	5.3	3.6	4.4	6.1	4.2	5.2

TABLE 20 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: C32ND4*P23A3/C33ND4*P23A3/C34ND4*P23A3

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	75.3	78.5	74.2	76.4	79.1	72.6	75.8
10	77.2	80.1	75.3	77.7	80.9	73.8	77.3
20	79.5	81.9	76.5	79.2	83.0	75.2	79.1
30	81.2	83.3	77.5	80.4	84.6	76.2	80.4
40	82.6	84.4	78.2	81.3	85.9	77.1	81.5
50	83.9	85.5	79.0	82.2	87.1	78.0	82.5
60	85.3	86.6	79.7	83.1	88.3	78.8	83.6
70	86.7	87.7	80.5	84.1	89.7	79.7	84.7
80	88.4	89.1	81.4	85.2	91.2	80.7	86.0
90	90.7	90.9	82.6	86.8	93.3	82.2	87.8
95	92.6	92.5	83.7	88.1	95.1	83.4	89.2
N	9	11	11	11	9	9	9
Mean	83.9	85.5	79.0	82.2	87.1	78.0	82.5
Estimated Std. Dev. of the Sample Population	5.2	4.2	2.9	3.6	4.9	3.3	4.1

TABLE 21

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: C32WT2*P31A4/C33WT2*P31A4/C34T2*P31A4

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	81.2	82.1	76.8	79.4	83.4	75.3	79.4
10	82.5	83.7	77.8	80.8	85.1	76.5	80.8
20	84.1	85.7	79.1	82.4	87.2	78.0	82.6
30	85.2	87.1	80.1	83.6	88.8	79.1	83.9
40	86.2	88.3	80.9	84.6	90.1	80.0	85.0
50	87.1	89.5	81.6	85.5	91.3	80.8	86.1
60	88.0	90.6	82.4	86.5	92.5	81.7	87.1
70	89.0	91.8	83.2	87.5	93.8	82.6	88.2
80	90.1	93.2	84.1	88.7	95.3	83.7	89.5
90	91.7	95.2	85.4	90.3	97.4	85.1	91.3
95	93.0	96.8	86.5	91.6	99.2	86.4	92.8
N	11	11	11	11	11	11	11
Mean	87.1	89.5	81.6	85.5	91.3	80.8	86.1
Estimated Std. Dev. of the Sample Population	3.6	4.5	2.9	3.7	4.8	3.4	4.1

TABLE 21 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: C32WT2*P31A4/C33WT2*P31A4/C34WT2*P31A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	76.6	80.1	75.5	77.8	81.2	73.9	77.5
10	78.3	81.8	76.6	79.2	82.7	74.9	78.8
20	80.3	83.9	78.0	80.9	84.5	76.2	80.3
30	81.7	85.3	78.9	82.1	85.8	77.1	81.4
40	82.9	86.6	79.7	83.1	86.9	77.8	82.4
50	84.1	87.7	80.5	84.1	88.0	78.6	83.3
60	85.2	88.9	81.3	85.1	89.1	79.3	84.2
70	86.4	90.1	82.1	86.1	90.2	80.0	85.1
80	87.9	91.6	83.0	87.3	91.5	80.9	86.2
90	89.8	93.6	84.3	89.0	93.3	82.2	87.7
95	91.5	95.3	85.4	90.4	94.8	83.2	89.0
N	9	11	11	11	9	9	9
Mean	84.1	87.7	80.5	84.1	88.0	78.6	83.3
Estimated Std. Dev. of the Sample Population	4.5	4.6	3.0	3.8	4.2	2.8	3.5

TABLE 22

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: C33AN2*P33A4/C34AN2*P33A4

Percent Satisfied	PRON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	85.1	84.7	78.5	81.6	85.0	76.5	80.7
10	86.3	86.3	79.6	82.9	86.7	77.7	82.2
20	87.8	88.2	80.8	84.5	88.8	79.1	84.0
30	88.8	89.6	81.7	85.7	90.3	80.2	85.2
40	89.7	90.8	82.5	86.7	91.6	81.0	86.3
50	90.6	91.9	83.2	87.6	92.8	81.9	87.4
60	91.4	93.0	84.0	88.5	94.0	82.7	88.4
70	92.3	94.2	84.7	89.5	95.3	83.6	89.5
80	93.4	95.6	85.6	90.6	96.8	84.7	90.7
90	94.9	97.5	86.9	92.2	98.9	86.1	92.5
95	96.1	99.1	88.0	93.5	100.7	87.3	94.0
N	11	12	12	12	12	12	12
Mean	90.6	91.9	83.2	87.6	92.8	81.9	87.4
Estimated Std. Dev. of the Sample Populatior	3.4	4.4	2.9	3.6	4.8	3.3	4.0

TABLE 22 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: C33AN2*P33A4/C34AN2*P33A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	84.3	83.3	77.6	80.4	83.3	75.4	79.4
10	85.1	85.0	78.7	81.8	84.6	76.3	80.4
20	86.0	87.1	80.0	83.5	86.1	77.3	81.7
30	86.7	88.5	81.0	84.8	87.2	78.0	82.6
40	87.3	89.8	81.9	85.8	88.1	78.7	83.4
50	87.8	91.0	82.6	86.8	89.0	79.2	84.1
60	88.4	92.2	83.4	87.8	89.9	79.8	84.9
70	89.0	93.5	84.2	88.8	90.8	80.5	85.6
80	89.6	94.9	85.2	90.1	91.9	81.2	86.6
90	90.6	97.0	86.6	91.8	93.4	82.2	87.8
95	91.3	98.7	87.7	93.2	94.7	83.1	88.9
N	6	11	11	11	7	7	7
Mean	87.8	91.0	82.6	86.8	89.0	79.2	84.1
Estimated Std. Dev. of the Sample Population	2.1	4.7	3.1	3.9	3.5	2.3	2.9

TABLE 23

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: C32HC2*P38A4/C33EC2*P38A4/C33HC2*P38A4/
C34HC2*P38A4/C34CC2*P38A4

Percent Satisfied	PR ON	FBRU			FBRSU		
		RON	MON	(R+M)/2	RON	MON	(R+M)/2
5	72.6	76.9	73.2	75.0	76.5	70.8	73.6
10	74.5	78.7	74.4	76.5	78.6	72.2	75.4
20	76.9	80.8	75.8	78.3	81.2	74.0	77.6
30	78.5	82.4	76.9	79.6	83.1	75.2	79.2
40	80.0	83.7	77.8	80.7	84.7	76.3	80.5
50	81.3	85.0	78.6	81.8	86.2	77.3	81.7
60	82.7	86.2	79.4	82.8	87.7	78.3	83.0
70	84.1	87.5	80.3	83.9	89.3	79.4	84.3
80	85.8	89.1	81.4	85.2	91.1	80.7	85.9
90	88.2	91.2	82.8	87.0	93.7	82.4	88.1
95	90.1	93.0	84.0	88.5	95.9	83.9	89.9
N	15	15	15	15	15	15	15
Mean	81.3	85.0	78.6	81.8	86.2	77.3	81.7
Estimated Std. Dev. of the Sample Population	5.3	4.9	3.3	4.1	5.9	4.0	4.9

TABLE 23 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: C32HC2*P38A4/C33EC2*P38A4/C33HC2*P38A4/ C34HC2*P38A4/C34CC2*P38A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	72.0	75.8	72.4	74.1	74.9	69.7	72.3
10	73.8	77.5	73.6	75.5	77.0	71.1	74.0
20	75.9	79.6	74.9	77.2	79.5	72.8	76.1
30	77.4	81.0	75.9	78.5	81.3	74.0	77.7
40	78.7	82.3	76.8	79.5	82.9	75.1	79.0
50	79.9	83.5	77.6	80.5	84.3	76.1	80.2
60	81.1	84.6	78.4	81.5	85.8	77.1	81.4
70	82.4	85.9	79.2	82.6	87.3	78.1	82.7
80	83.9	87.4	80.2	83.8	89.2	79.3	84.3
90	86.0	89.4	81.6	85.5	91.7	81.1	86.4
95	87.7	91.1	82.7	86.9	93.8	82.5	88.1
N	9	14	14	14	9	9	9
Mean	79.9	83.5	77.6	80.5	84.3	76.1	80.2
Estimated Std. Dev. of the Sample Population	4.8	4.6	3.1	3.9	5.8	3.9	4.8

TABLE 24

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: S15XL2*P40A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	77.2	79.5	74.9	77.2	81.7	74.2	77.9
10	79.4	81.6	76.3	79.0	83.6	75.5	79.5
20	82.0	84.1	78.0	81.1	85.9	77.1	81.5
30	83.9	85.9	79.3	82.6	87.5	78.3	82.9
40	85.5	87.4	80.3	83.9	89.0	79.3	84.1
50	87.0	88.8	81.3	85.1	90.3	80.2	85.3
60	88.5	90.3	82.2	86.3	91.6	81.1	86.4
70	90.1	91.8	83.3	87.6	93.1	82.1	87.6
80	92.0	93.6	84.5	89.1	94.7	83.3	89.0
90	94.6	96.1	86.2	91.2	97.0	84.9	91.0
95	96.8	98.2	87.6	92.9	98.9	86.2	92.6
N	9	10	10	10	10	10	10
Mean	87.0	88.8	81.3	85.1	90.3	80.2	85.3
Estimated Std. Dev. of the Sample Population	5.9	5.7	3.9	4.8	5.3	3.7	4.5

TABLE 24 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: S15XL2*P40A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	76.0	78.4	74.2	76.3	80.2	73.3	76.8
10	78.2	80.5	75.7	78.1	81.7	74.3	78.0
20	80.9	83.0	77.4	80.2	83.4	75.5	79.4
30	82.8	84.9	78.6	81.8	84.7	76.3	80.5
40	84.5	86.5	79.7	83.1	85.7	77.0	81.4
50	86.0	87.9	80.7	84.3	86.7	77.7	82.2
60	87.5	89.4	81.7	85.5	87.8	78.4	83.1
70	89.2	91.0	82.7	86.9	88.8	79.1	84.0
80	91.1	92.9	84.0	88.4	90.1	80.0	85.0
90	93.8	95.4	85.7	90.5	91.8	81.2	86.5
95	96.0	97.5	87.1	92.3	93.3	82.1	87.7
N	8	10	10	10	8	8	8
Mean	86.0	87.9	80.7	84.3	86.7	77.7	82.2
Estimated Std. Dev. of the Sample Population	6.1	5.8	3.9	4.9	4.0	2.7	3.3

TABLE 25

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Maximum
SELECT MODEL: S36RK2*T57A4/V36GK2*T57A4/P36CK2*T57A4/ S36UK2*T57A4/P36KK2*T57A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	85.5	85.9	79.3	82.6	86.5	77.6	82.0
10	86.4	86.9	80.0	83.4	87.5	78.3	82.9
20	87.6	88.2	80.8	84.5	88.8	79.1	83.9
30	88.4	89.1	81.3	85.2	89.7	79.7	84.7
40	89.1	89.8	81.8	85.8	90.5	80.2	85.4
50	89.8	90.5	82.3	86.4	91.2	80.7	86.0
60	90.4	91.3	82.8	87.0	91.9	81.2	86.6
70	91.1	92.0	83.3	87.7	92.7	81.7	87.2
80	92.0	92.9	83.9	88.4	93.6	82.3	88.0
90	93.1	94.2	84.7	89.4	94.8	83.2	89.0
95	94.1	95.2	85.3	90.3	95.9	83.9	89.9
N	11	11	11	11	11	11	11
Mean	89.8	90.5	82.3	86.4	91.2	80.7	86.0
Estimated Std. Dev. of the Sample Population	2.6	2.8	1.8	2.3	2.9	1.9	2.4

TABLE 25 (Continued)

MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Knock Sensor Select Model - Minimum Borderline
SELECT MODEL: S36RK2*T57A4/V36GK2*T57A4/P36CK2*T57A4/
S36UK2*T57A4/P36KK2*T57A4

Percent Satisfied	PR ON	FBRU RON	FBRU MON	FBRU (R+M)/2	FBRSU RON	FBRSU MON	FBRSU (R+M)/2
5	84.4	85.2	78.8	82.0	85.9	77.2	81.6
10	85.5	86.1	79.4	82.8	86.9	77.8	82.4
20	86.9	87.3	80.2	83.7	88.0	78.6	83.3
30	87.9	88.2	80.7	84.4	88.8	79.1	84.0
40	88.7	88.9	81.2	85.0	89.5	79.6	84.6
50	89.5	89.5	81.7	85.6	90.2	80.0	85.1
60	90.3	90.2	82.1	86.2	90.9	80.5	85.7
70	91.1	90.9	82.6	86.8	91.6	80.9	86.2
80	92.1	91.8	83.1	87.5	92.4	81.5	86.9
90	93.5	93.0	83.9	88.4	93.5	82.2	87.9
95	94.6	93.9	84.5	89.2	94.5	82.9	88.7
N	3	10	10	10	5	5	5
Mean	89.5	89.5	81.7	85.6	90.2	80.0	85.1
Estimated Std. Dev. of the Sample Population	3.1	2.7	1.7	2.2	2.6	1.7	2.2

TABLE 26

OWNER/RATER COMPARISON OF TANK FUEL KNOCK

(1982-1989 CRC Octane Number Requirement Surveys)

Model Year:	1989	1988	1987	1986	1985	1984	1983	1982
Fuel:	Unleaded	Unleaded	Unleaded	Unleaded	Unleaded	Unleaded	Unleaded	Unleaded
Total Reports:	124	155	179	160	143	149	129	144
Percent Knocking								
Trained Rater	30.6	39.4	39.7	33.1	37.8	51.7	59.7	47.9
Owner	7.3	15.5	24.0	16.3	18.9	26.2	29.5	25.0
Owner/Rater Ratio	0.24	0.39	0.61	0.49	0.50	0.51	0.49	0.52
Percent Owners Objecting								
Based on:								
Total Reports	0.8	0.6	2.8	2.5	9.8	7.4	12.4	13.2
Owners Reporting Knock	11.1	4.2	11.6	15.4	51.9	28.2	42.1	52.8

TABLE 27

TANK-FUEL KNOCK REPORTED BY TRAINED OBSERVERS

I. Total Vehicles

Model Year	No. Survey	Vehicles Tested on Tank Fuel: No. Tested	Vehicles Tested on Tank Fuel: % Knocking (Wtg. Avg.)
1989	391	265	30
1988	391	293	31
1987	389	322	35
1986	377	330	31
1985	374	327	37
1984	407	358	49
1983	383	314	45
1982	434	342	42

II. 1989 Select Models	No. in Survey	No. Tested	% Knocking
C11BU2*P30A44	10	3	33
C21RC3*P22A4	11	7	14
C21D42*P38A4/C21S42*P38A4/ C22S42*P38A4	23	14	50
C21PF2*P50A4/C22PF2*P50A4/ C24PF2*P50A4	10	8	38
C31AR2*T25A3/C32AR2*T25A3/ C33AR2*T25A3/ C34AR2*T25A3/C34NR2*T25A3	11	10	30
C31AW2*P28A4/C32AW2*P28A4/ C32WW2*P28A4/ C33AW2*P28A4/C33WW2*P28A4/ C34WW2*P28A4	23	14	43
C31J12*T20A3/C31L12*T20A3	11	6	0
C32ND4*P23A3/C33ND4*P23A3/ C34ND4*P23A3	12	7	14
C32WT2*P31A4/C33WT2*P31A4/ C34WT2*P31A4	11	8	37
C33AN2*P33A4/C34AN2*P33A4	12	9	44
C32HC2*P38A4/C33EC2*P38A4/ C33HC2*P38A4	15	9	11
S15XL2*P40A4	10	9	22
S36RK2*T57A4/V36GK2*T57A4/ P36CK2*T57A4/ S36UK2*T57A4/P36KK2*T57A4	11	3	67

* weighted average

TABLE 28

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Percent of Vehicles Having Maximum Requirements Within Specified Speed (rpm) Ranges

Model:	C11BU2*P30A44 (Maximum)			C11BU2*P30A44 (Minimum-Borderline)			C21RC3*P22A4		
Max Torque, RPM	3600			3600			3000		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	20	10	0	13	10	0	0	0	0
1600 - 1999	50	30	20	61	30	13	10	0	0
2000 - 2399	20	0	0	13	10	36	50	55	64
2400 - 2799	10	20	0	13	10	13	30	45	36
2800 - 3199	0	20	20	0	20	0	10	0	0
3200 and Higher	0	20	60	0	10	38	0	0	0
No. of Vehicles	10	10	10	8	8	10	10	11	11

Knock Sensor, Maximum

Model:	C21D42*P38A4/ C21S42*P38A4/ C22S42*P38A4			C21PF2*P50A4/ C22PF2*P50A42*P50A4/ C24PF2*P50A4			C31AR2*T25A3/C32AR2*T25 C33AR2*T25A3/ C34AR2*T25A3/C34NR2*T25		
Max Torque, RPM	2200			2000			3200		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	31	27	17	80	80	80	20	37	9
1600 - 1999	17	4	0	10	0	0	20	9	9
2000 - 2399	22	13	4	10	0	0	30	18	18
2400 - 2799	13	13	13	0	20	20	20	0	9
2800 - 3199	13	17	17	0	0	0	0	9	9
3200 and Higher	4	26	49	0	0	0	10	27	46
No. of Vehicles	23	23	23	10	10	10	11	11	11

TABLE 28 (Continued)

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Percent of Vehicles Having Maximum Requirements Within Specified Speed (rpm) Ranges

Model:	C31AW2*P28A4/C32AW2*P28A4/ C32WW2*P28A4/C33AW2*P28A4/ C33WW2*P28A4/C34WW2*P28A4 (Maximum)			C31AW2*P28A4/C32AW2*P28A4/ C32WW2*P28A4/C33AW2*P28A4/ C33WW2*P28A4/C34WW2*P28A4 (Minimum-Borderline)			C31J12*T20A3/ C31L12*T20A3		
Max Torque, RPM	3600			3600			3200		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	9	4	0	14	14	0	0	0	0
1600 - 1999	40	39	27	36	29	44	30	37	46
2000 - 2399	17	9	17	14	14	14	10	18	18
2400 - 2799	4	17	26	0	14	21	40	36	27
2800 - 3199	17	22	26	36	24	21	20	9	9
3200 and Higher	13	9	4	0	5	0	0	0	0
No. of Vehicles	23	23	23	14	21	14	10	11	11

Knock Sensor, Maximum Model:	C32ND4*P23A3/C33ND4*P23A3/ C34ND4*P23A3 (Maximum)			C32ND4*P23A3/C33ND4*P23A3/ C34ND4*P23A3 (Minimum-Borderline)			C32WT2*P31A4/C33WT2*P31 C34WT2*P31A4 (Maximum)		
Max Torque, RPM	4000			4000			3600		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	20	20	0	25	25	0	0	9	9
1600 - 1999	20	30	55	13	50	71	64	27	27
2000 - 2399	50	40	45	49	25	29	9	0	9
2400 - 2799	10	10	0	13	0	0	0	27	18
2800 - 3199	0	0	0	0	0	0	27	37	37
3200 and Higher	0	0	0	0	0	0	0	0	0
No. of Vehicles	12	12	12	9	11	9	11	11	11

TABLE 28 (Continued)

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Percent of Vehicles Having Maximum Requirements Within Specified Speed (rpm) Ranges

Model:	C32WT2*P31A4/C33WT2*P31A4/ C34WT2*P31A4 (Minimum Borderline)			C33AN2*P33A4/C34AN2*P33A4 (Maximum)			C33AN2*P33A4/C34AN2*P33A (Minimum Borderline)		
Max Torque, RPM	3600			2000			2000		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	0	0	0	37	25	25	17	46	28
1600 - 1999	74	46	56	36	58	42	49	27	29
2000 - 2399	13	9	0	27	17	33	17	27	29
2400 - 2799	0	9	33	0	0	0	0	0	14
2800 - 3199	13	27	11	0	0	0	17	0	0
3200 and Higher	0	9	0	0	0	0	0	0	0
No. of Cars	9	11	9	11	12	12	6	11	7

Model:	C32HC2*P38A4/C33EC2*P38A4/ C33HC2*P38A4/C34HC2*P38A4 (Maximum)			C32HC2*P38A4/C33EC2*P38A4/ C33HC2*P38A4/C34HC2*P38A4 (Minimum Borderline)			S15XL2*P40A4 (Maximum)		
Max Torque, RPM	2000			2000			2500		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	30	20	10	0	11	0	34	10	10
1600 - 1999	20	20	0	20	11	20	11	10	30
2000 - 2399	30	30	70	60	45	60	11	30	10
2400 - 2799	10	10	10	20	11	20	33	0	0
2800 - 3199	10	20	10	0	22	0	0	50	50
3200 and Higher	0	0	0	0	0	0	11	0	0
No. of Cars	15	15	15	9	14	9	9	10	10

TABLE 28 (Continued)

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS - 1989 SELECT MODELS

Percent of Vehicles Having Maximum Requirements Within Specified Speed (rpm) Ranges

Model:	S15XL2*P40A4 (Minimum-Borderline)			S36RK2*T57A4/V36GK2*T57A4/ P36CK2*T57A4 S36UK2*T57A4/ P36KK2*T57A4 (Maximum)			S36RK2*T57A4/V36GK2*T57A P36CK2*T57A4 S36UK2*T57A P36KK2*T57A4 (Minimum-Borderline)		
Max Torque, RPM	2500			2800			2800		
Fuel:	PR	FBRU	FBRSU	PR	FBRU	FBRSU	PR	FBRU	FBRSU
SPEED RANGE									
1599 and Lower	25	10	0	0	0	0	0	10	0
1600 - 1999	13	20	13	18	36	18	67	30	40
2000 - 2399	13	20	25	73	46	64	33	50	40
2400 - 2799	36	0	13	0	9	9	0	10	20
2800 - 3199	0	50	49	9	0	0	0	0	0
3200 and Higher	13	0	0	0	9	9	0	0	0
No. of Vehicles	8	10	8	11	11	11	3	10	5

TABLE 29

ENGINE SPEEDS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS

Weighted % of Vehicles Having Requirements
in Indicated (rpm) Ranges

All 1989 Vehicles

Maximum Requirements Engine Speed Range	PR Fuels	FBRU Fuels	FBRSU Fuels
1599 and Lower	20	20	13
1600 - 1999	21	15	13
2000 - 2399	22	25	26
2400 - 2799	19	19	20
2800 - 3199	13	14	17
3200 - 3599	3	3	5
3600 and Higher	2	4	6

TABLE 30

THROTTLE/GEAR POSITION FOR 1989 MAXIMUM

FBRU OCTANE NUMBER REQUIREMENTS

Throttle Position	Transmission Type & Gear		No. of Vehicles*	% of Vehicles
	Automatic Transmission			
Maximum	4-Speed:	4th	44	13.6
		3rd	72	22.2
		2nd	47	14.5
	3-Speed:	3rd	54	16.7
		2nd	30	9.3
Part	4-Speed:	4th	36	11.1
		3rd	13	4.0
		2nd	3	0.9
	3-Speed	3rd	23	7.1
		2nd	2	0.6
			324	100.0
	Manual Transmission			
Maximum	5-Speed:	4th	19	35.1
		3rd	13	24.1
		2nd	1	1.9
	4-Speed:	4th	1	1.9
Part	5-Speed:	4th	12	22.2
		3rd	6	11.1
	4-Speed:	4th	2	3.7
			54	100.0

* Twelve test vehicles not counted, because all FBRU fuels satisfied their octane number requirements. One missing value for gear position.

Figure 1

DISTRIBUTION OF ODOMETER MILEAGE FOR 1989 MODEL VEHICLES TESTED

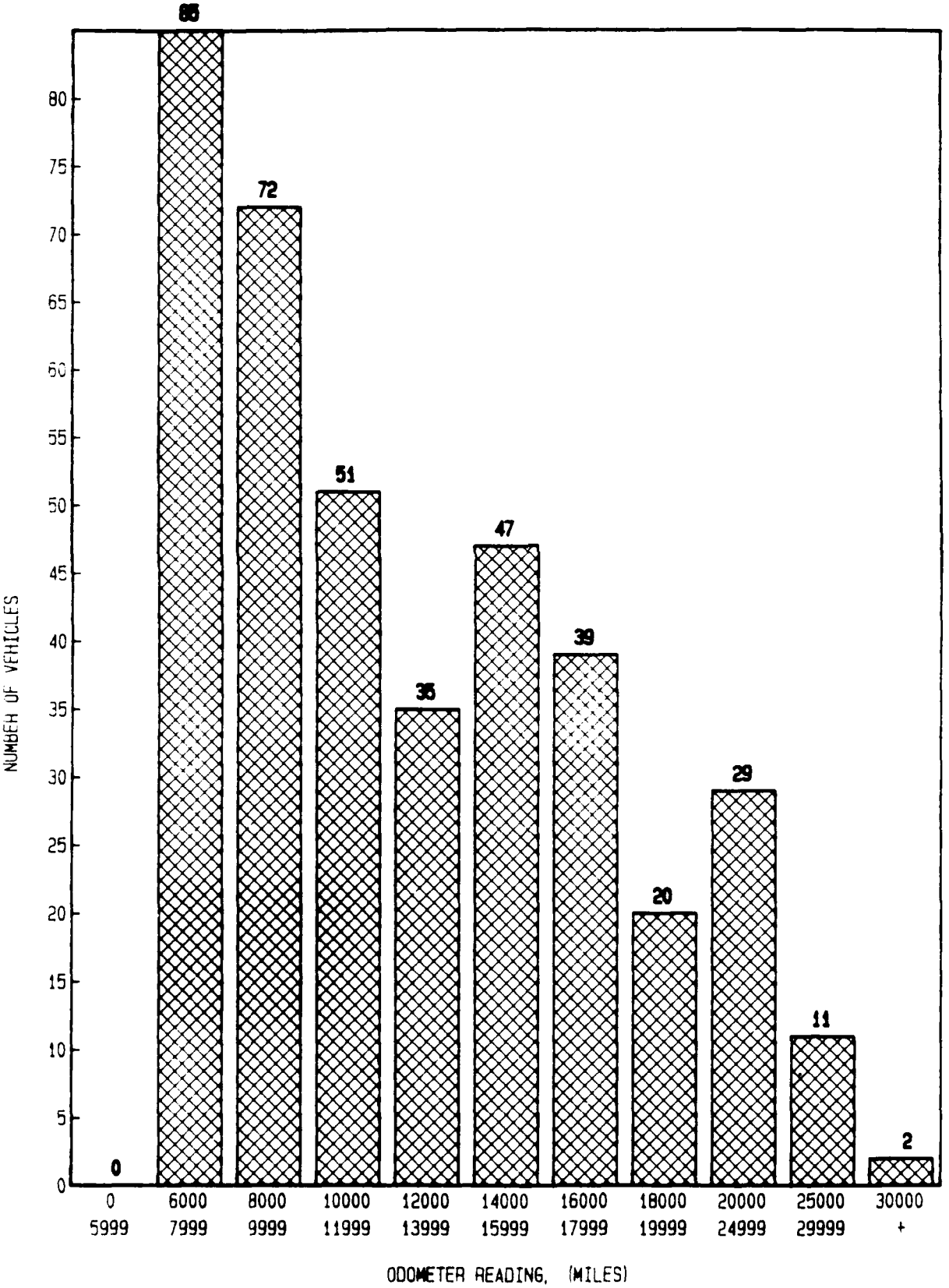


Figure 2
DISTRIBUTION OF MAXIMUM PR FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL VEHICLES

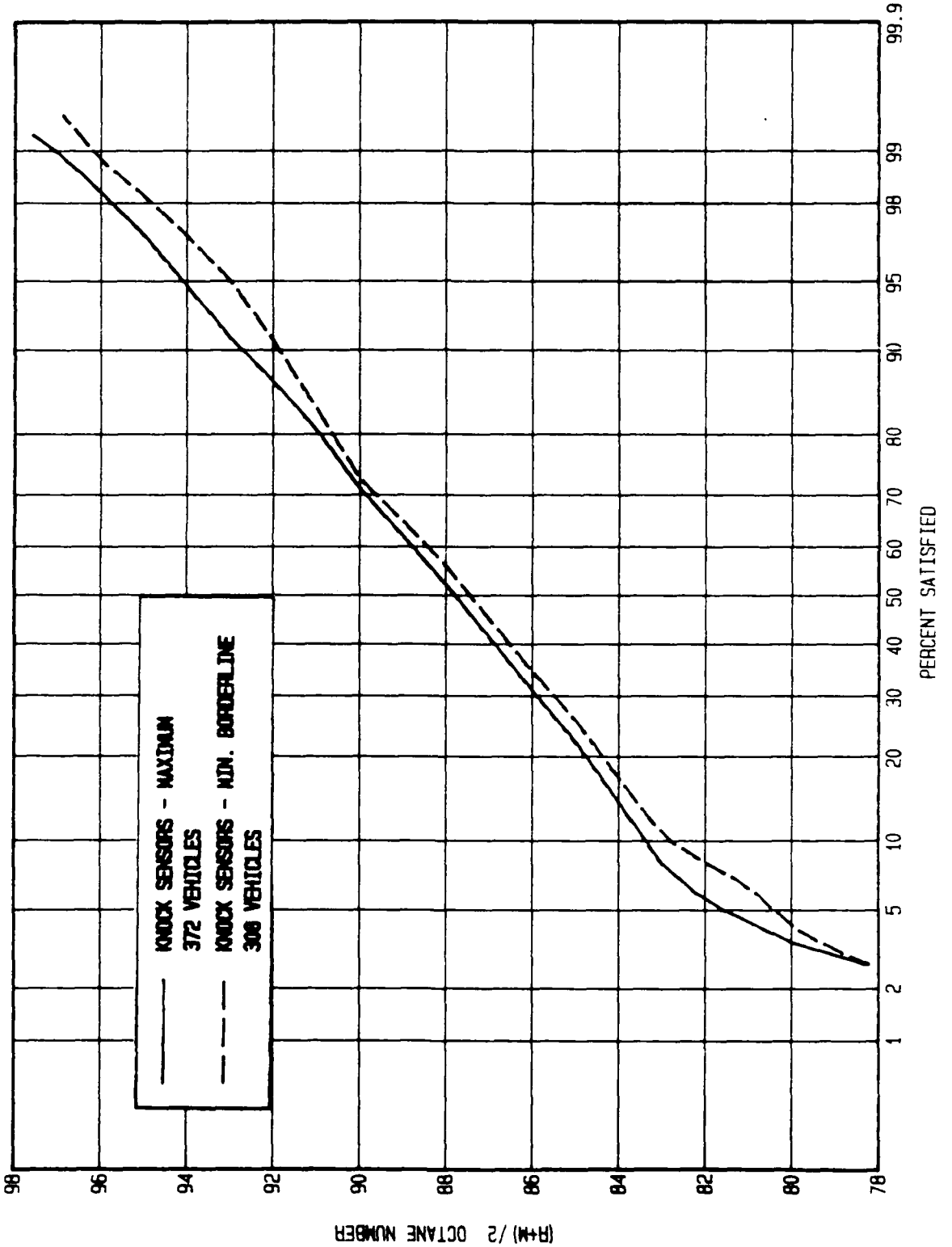


Figure 3
DISTRIBUTION OF MAXIMUM FBRU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL VEHICLES

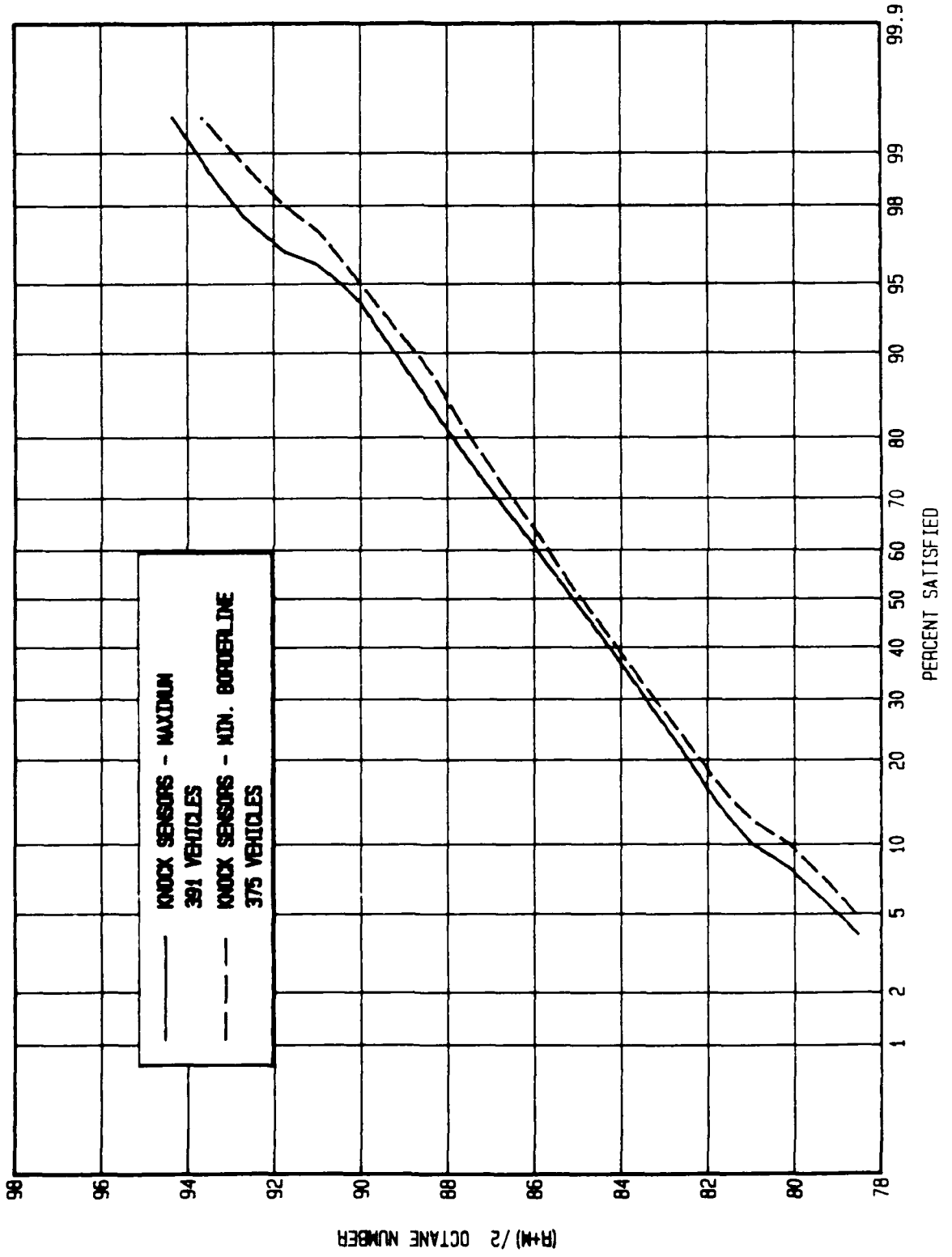


Figure 4
DISTRIBUTION OF MAXIMUM FBRSU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL VEHICLES

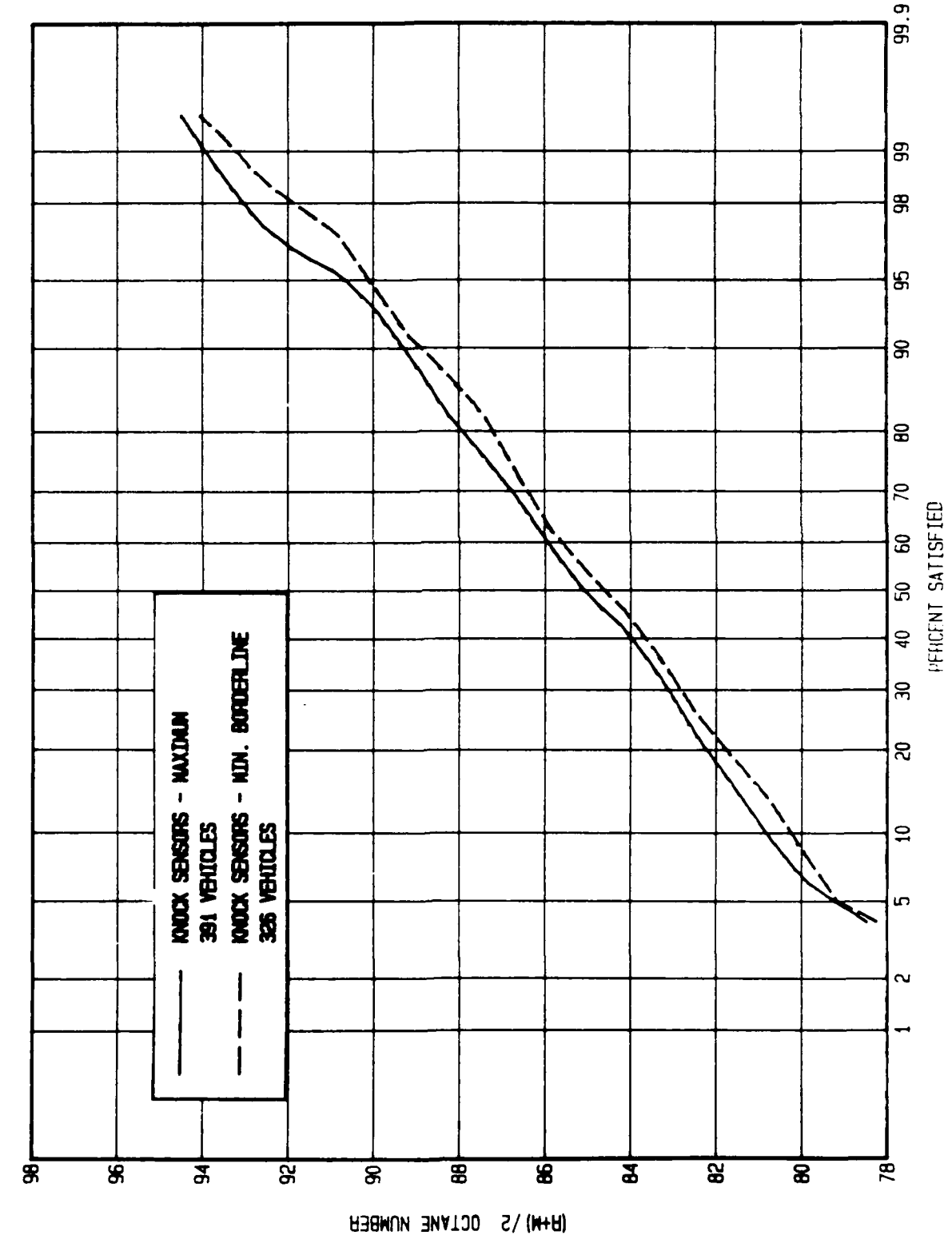


Figure 5
DISTRIBUTION OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL VEHICLES

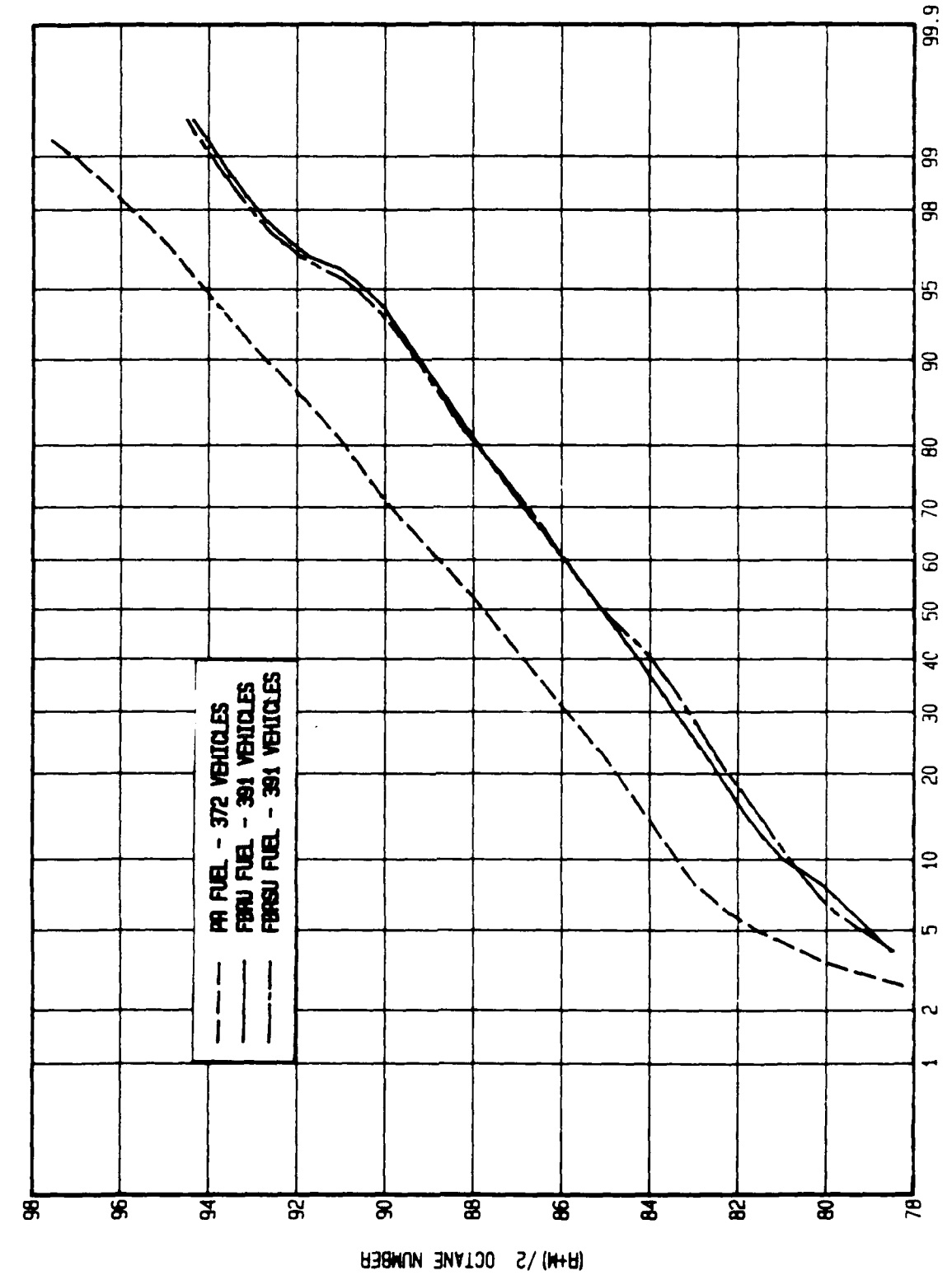


Figure 6
DISTRIBUTION OF MAXIMUM FBRU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 AND 1988 TOTAL VEHICLES

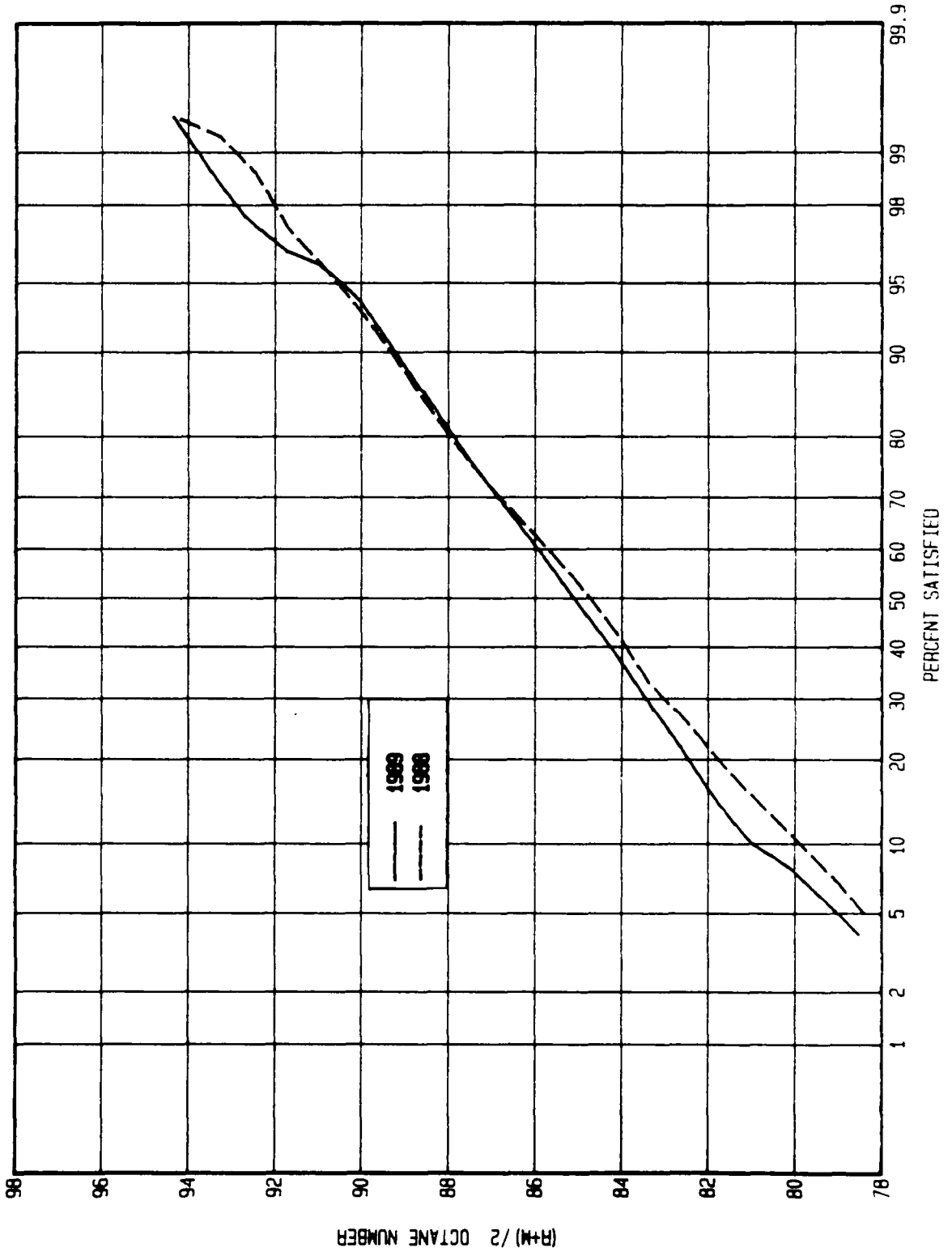


Figure 7
DISTRIBUTION OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL CARS

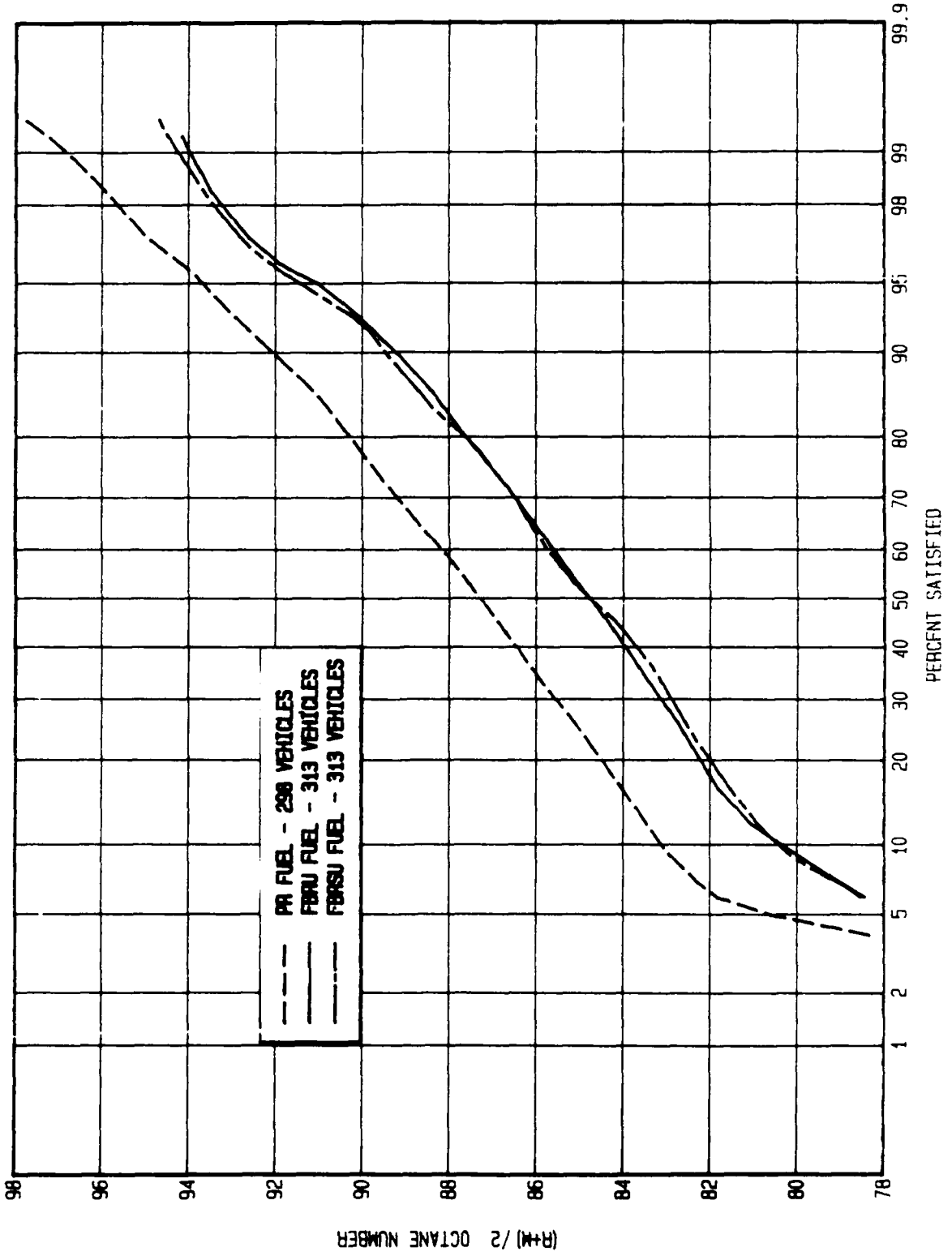


Figure 8
DISTRIBUTION OF MAXIMUM FBRU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 AND 1988 TOTAL CARS

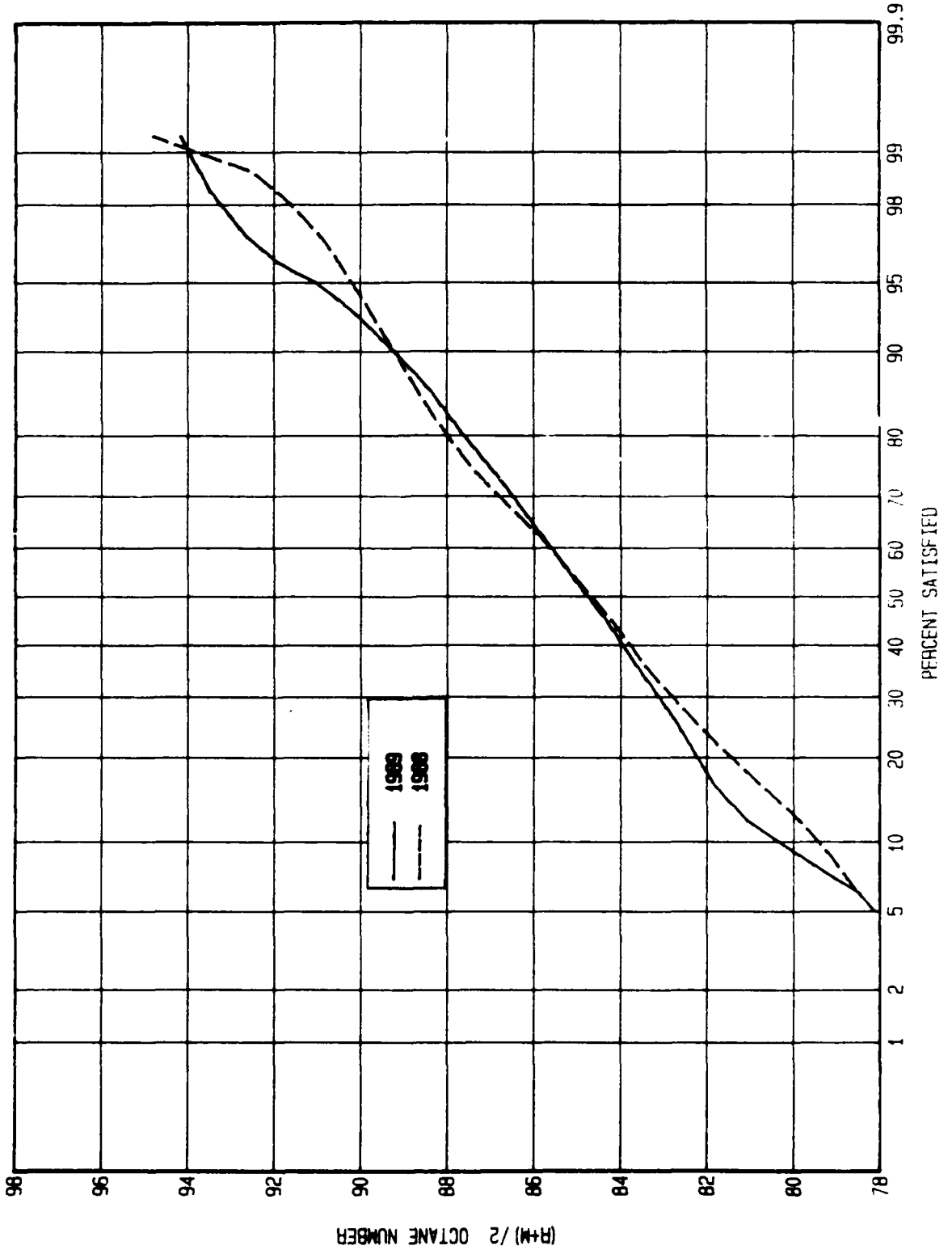


Figure 9
DISTRIBUTION OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 TOTAL TRUCKS AND VANS

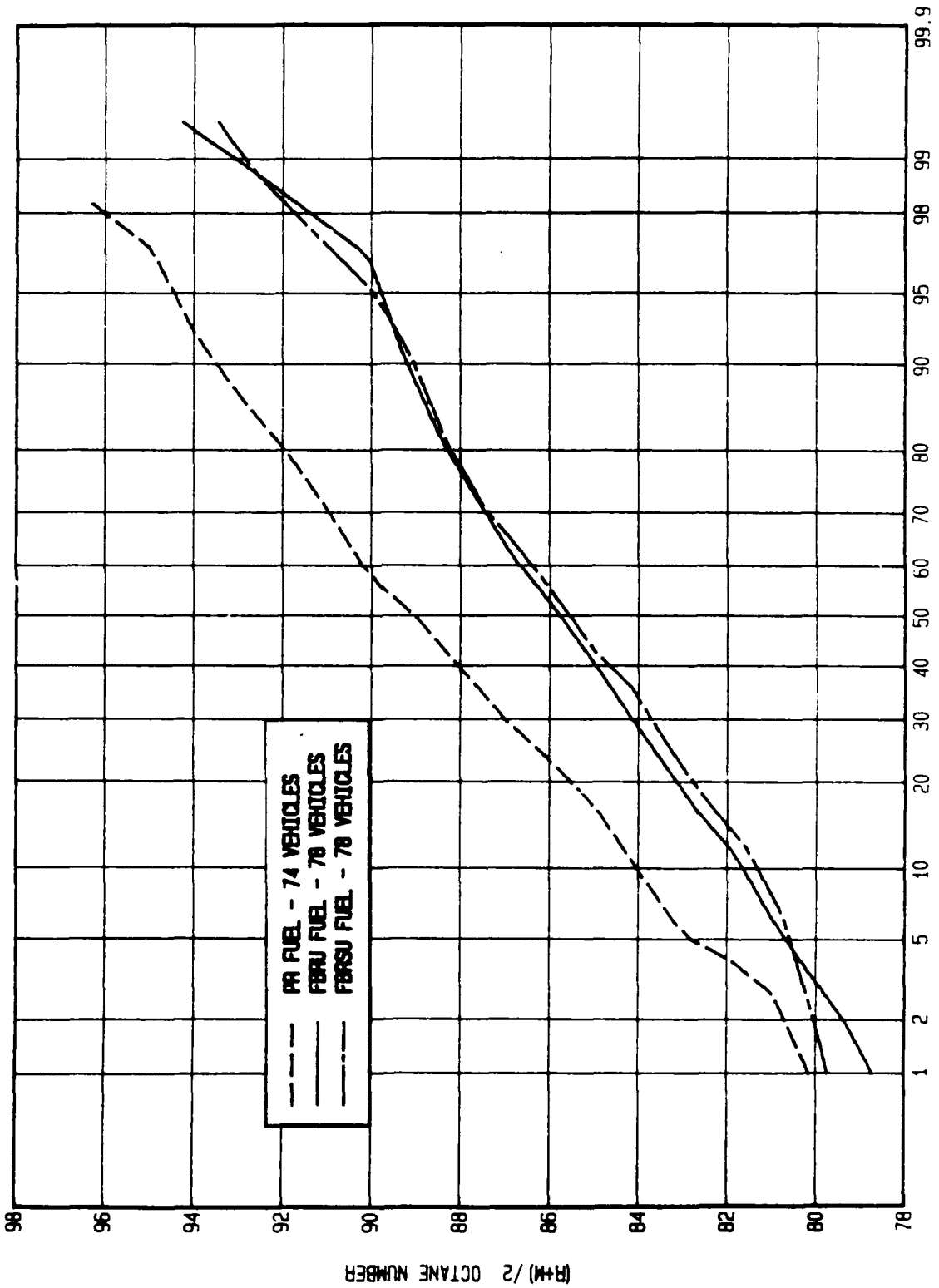


Figure 10
DISTRIBUTION OF MAXIMUM FBRU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 AND 1988 TOTAL TRUCKS AND VANS

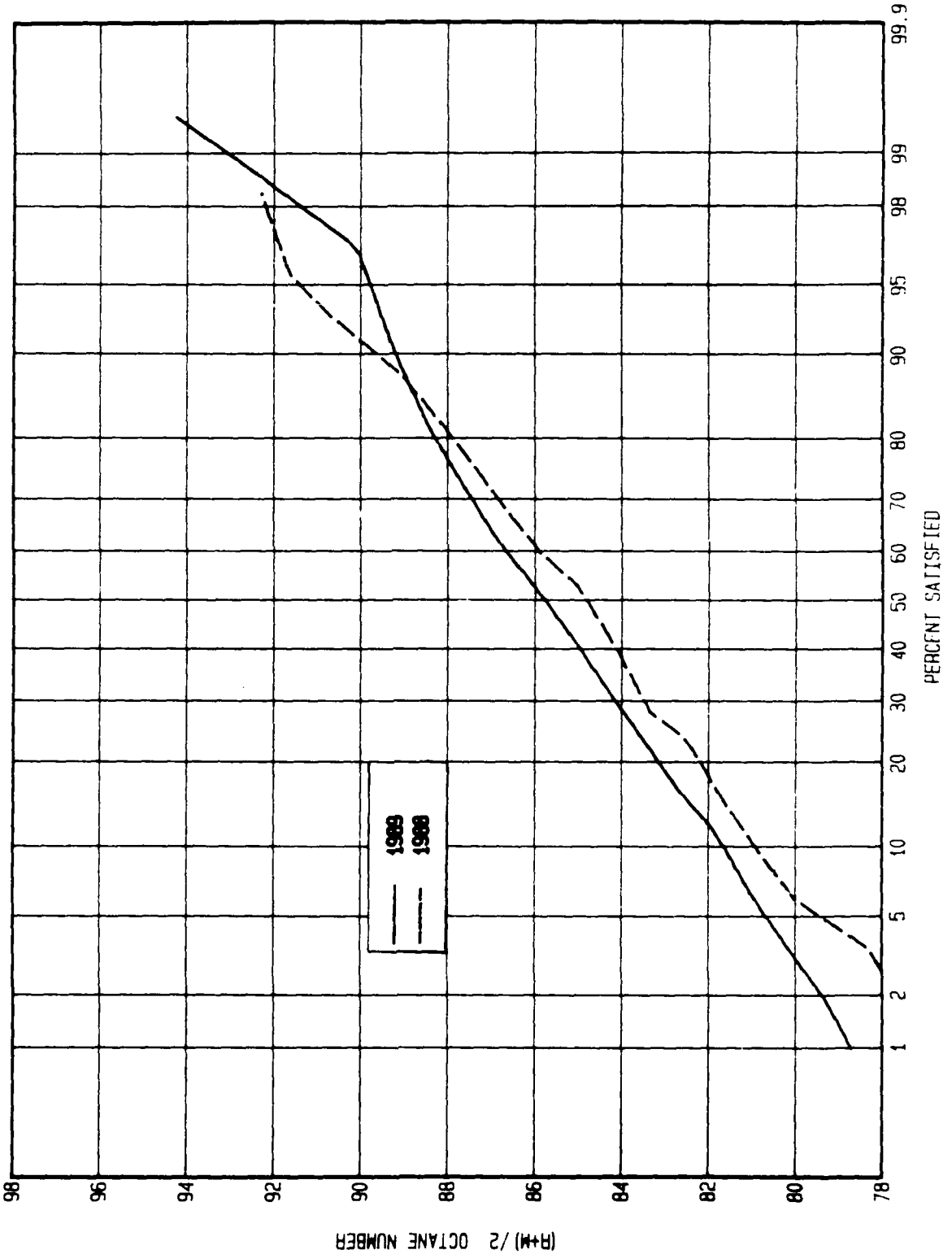


Figure 11
DISTRIBUTION OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 KNOCK SENSOR VEHICLES

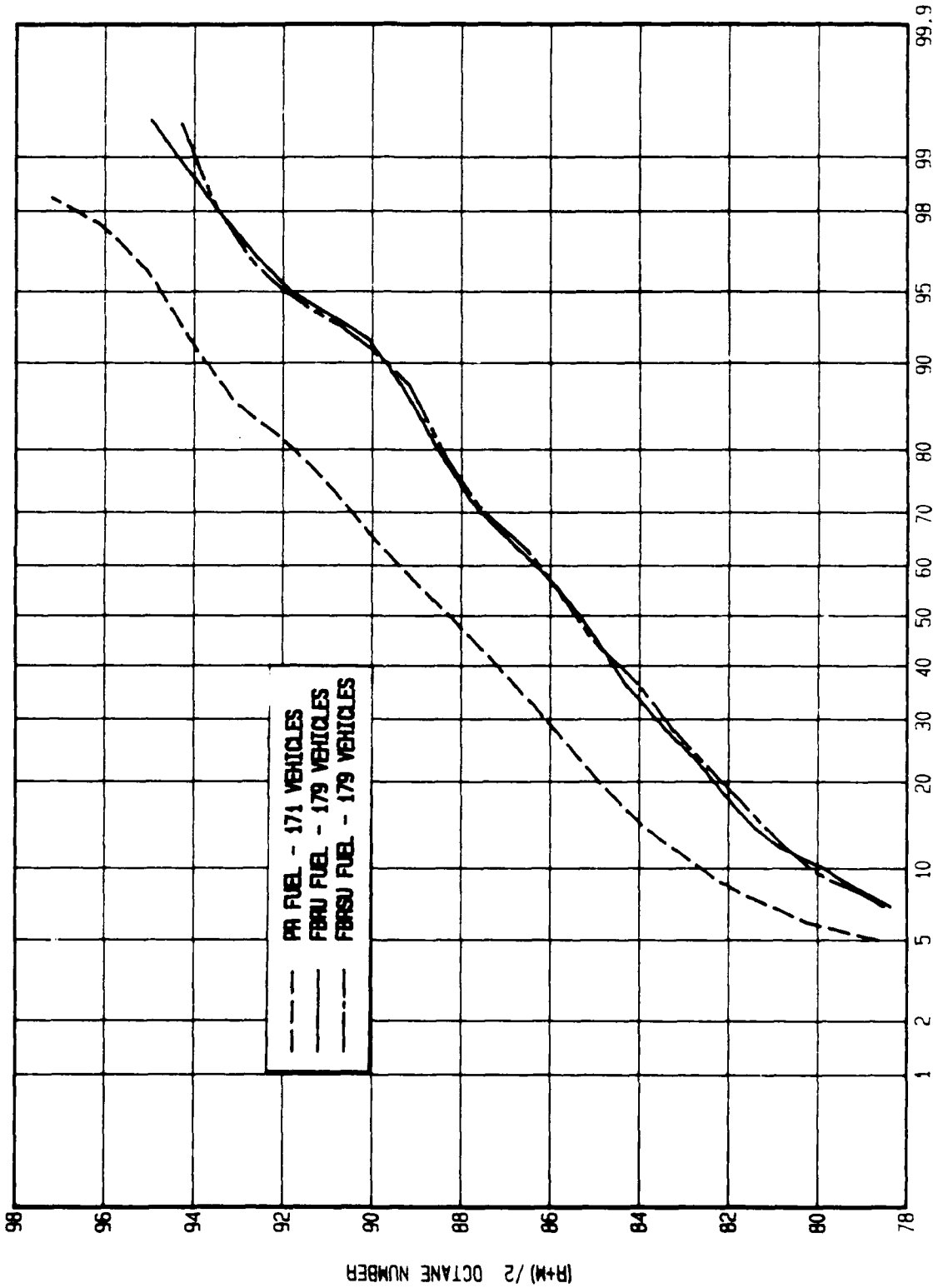


Figure 12
DISTRIBUTION OF MAXIMUM (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 KNOCK SENSOR VEHICLES - MINIMUM BORDERLINE

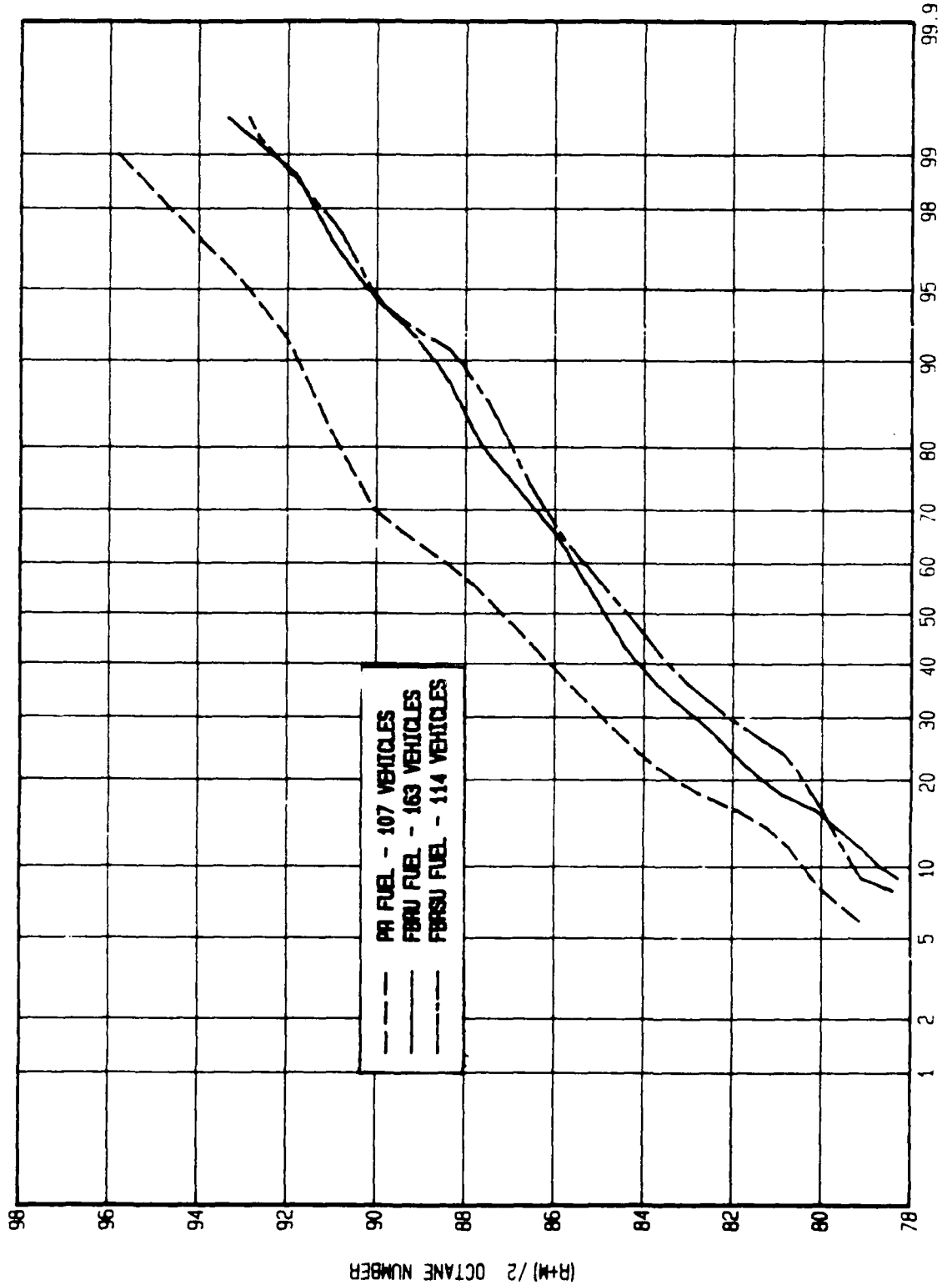
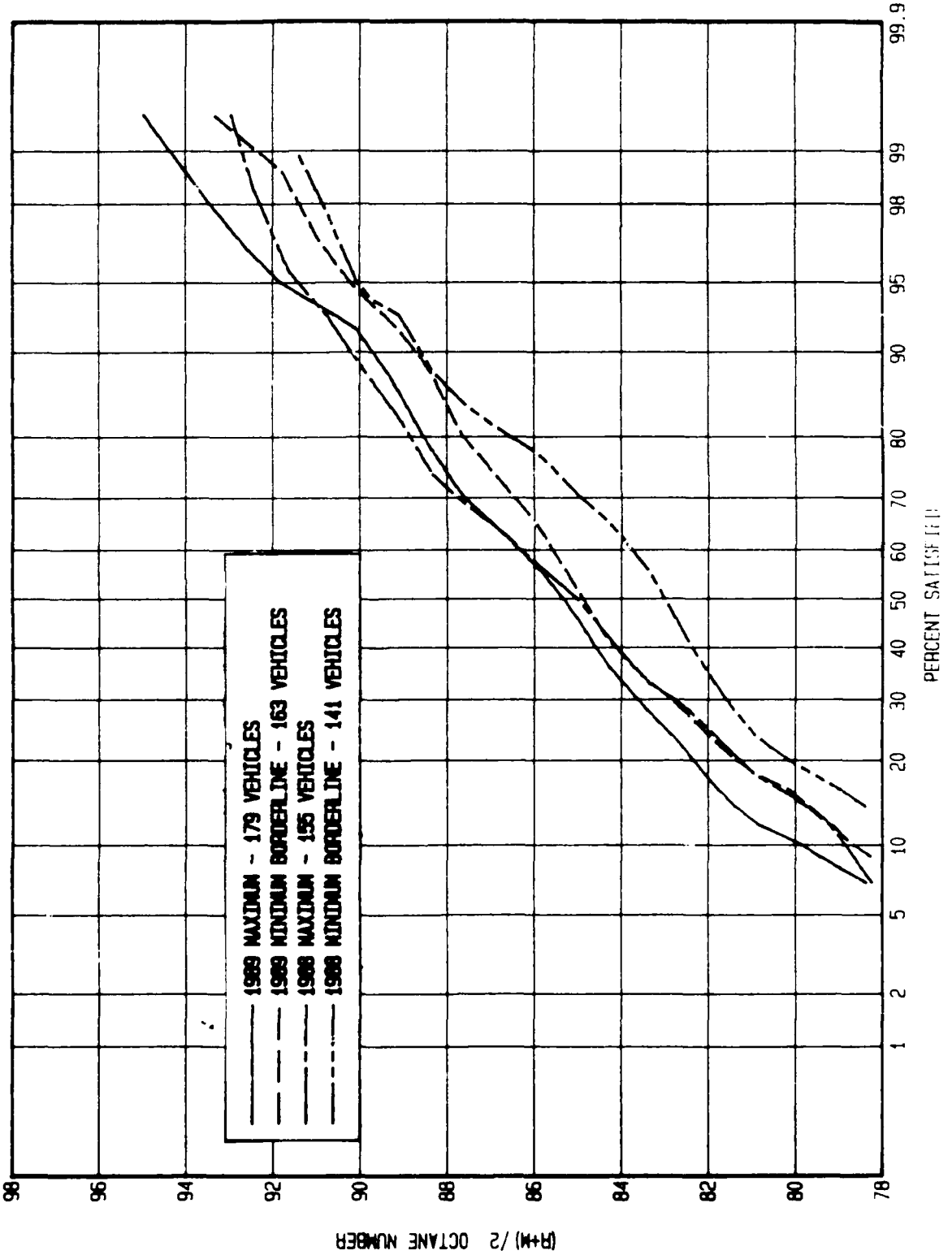


Figure 13
DISTRIBUTION OF MAXIMUM FBRU FUEL (R+M)/2 OCTANE NUMBER REQUIREMENTS
1989 AND 1988 KNOCK SENSOR VEHICLES



PARTICIPATING LABORATORIES

No. of Vehicles Tested	Eastern Area	East Central Area	No. of Vehicles Tested
21	Exxon Res. & Engrg. Co. Linden, NJ	Ashland Oil Ashland, KY	6
31	Mobil Res. & Dev. Corp. Paulsboro, NJ	BP Oil Company Cleveland, OH	31
19	Sun Company Marcus Hook, PA	Ford Motor Company Dearborn, MI	18
30	Texaco Inc. Beacon, NY	General Motors Research Labs Warren, MI	30
		Nissan Res. & Dev. Ann Arbor, MI	7
		Petro-Canada Products Sheridan Park, Ontario	30
		Shell Canada Oakville, Ontario	7
		Toyota Motor Corp. Ann Arbor, MI	9
	Western Area	**West Central Area**	
30	Chevron Res. & Technology Co. Richmond, CA	Chrysler Corporation Detroit, MI	22
29	Unocal Corporation Brea, CA	Amoco Oil Company Naperville, IL	32
		Phillips Petroleum Co. Bartlesville, OK	16
		Shell Development Co. Houston, TX	23

A P P E N D I X B

MEMBERSHIP: 1989 ANALYSIS PANEL

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

1989 ANALYSIS PANEL

Name	Company
D. I. Hoel, Leader	Exxon Research and Engineering Company
W. F. Biller	Consultant
C. J. Bones	Sun Refining and Marketing Company
J. C. Callison	Amoco Oil Company
C. A. Carlson	Texaco, Inc.
J. P. Graham	Chevron Research and Technology Company
M. T. Noorman	Mobil Oil Corporation
M. G. Rogers	Mobil Research and Development Corporation
J. P. Uihlein	BP Oil Company (Sohio)
T. Wusz	Unocal Corporation

APPENDIX C

DATA ON 1989/1990

FULL-BOILING RANGE REFERENCE FUELS

TABLE C-1

SUPPLIERS' FUEL INSPECTIONS

1989/1990 FBRU FUELS

	Low-Octane Base Blend RMFD 368-89/90	Intermediate-Octane Base Blend RMFD 369-89/90	High-Octane Base Blend RMFD 370-89/90
Laboratory Inspection			
Distillation, °F			
IBP	91	90	90
10% Evap.	136	118	127
30% Evap.	176	152	182
50% Evap.	209	196	218
70% Evap.	233	250	248
90% Evap.	325	334	286
End Point	426	425	357
RVP, psi	7.1	8.3	7.5
Lead, g/gal.	0.000	0.000	0.000
Oxidation Stab., min.	1440+	1440+	1440+
Hydrocarbon Type, Vol. %			
Aromatics	19.6	25.7	46.4
Olefins	10.0	15.0	3.2
Saturates	70.4	59.3	50.4
Research Octane Number	79.3	90.6	104.2
Motor Octane Number	74.5	82.2	92.7
Sensitivity	4.8	8.4	11.5

TABLE C-2

OCTANE NUMBERS AND COMPOSITIONS FOR 1989/1990 FBRU FUELS

Research Octane Number	Volume Percent RMFD 368-89/90	RMFD 369-89/90	RMFD 370-89/90	Motor Octane Number	Sensitivity
80	91.5	8.5	---	75.2	4.8
82	75.0	25.0	---	76.7	5.3
84	59.0	41.0	---	78.1	5.9
85	51.0	49.0	---	78.7	6.3
86	42.5	57.5	---	79.4	6.6
87	34.0	66.0	---	80.0	7.0
88	25.0	75.0	---	80.7	7.3
89	15.5	84.5	---	81.3	7.7
90	5.0	95.0	---	81.9	8.1
91	---	96.5	3.5	82.6	8.4
92	---	90.0	10.0	83.3	8.7
93	---	83.5	16.5	83.9	9.1
94	---	76.5	23.5	84.5	9.5
95	---	69.5	30.5	85.2	9.8
96	---	62.5	37.5	85.9	10.1
97	---	55.0	45.0	86.6	10.4
98	---	48.0	52.0	87.3	10.7
99	---	40.5	59.5	88.0	11.0
100	---	32.5	67.5	88.8	11.2
101	---	24.0	76.0	89.6	11.4
102	---	16.0	84.0	90.4	11.6
103	---	8.0	92.0	91.4	11.6
104	---	0.0	100.0	92.6	11.4

TABLE C-3

SUPPLIERS' FUEL INSPECTIONS

1989/1990 FBRSU FUELS

	Low-Octane Base Blend RMFD 371-89/90	Intermediate-Octane Base Blend RMFD 372-89/90	High-Octane Base Blend RMFD 373-89/90
Laboratory Inspection			
Distillation, °F			
IBP	90	97	91
10% Evap.	135	127	137
30% Evap.	174	158	190
50% Evap.	207	206	232
70% Evap.	247	280	256
90% Evap.	365	369	312
End Point	431	430	402
RVP, psi	8.1	7.1	7.5
Lead, g/gal.	0.000	0.000	0.000
Oxidation Stab., min.	1440+	1440+	1440+
Hydrocarbon Type, Vol. %			
Aromatics	23.7	31.5	50.4
Olefins	29.9	21.5	3.8
Saturates	46.4	47.0	45.8
Research Octane Number	79.5	91.6	104.0
Motor Octane Number	72.9	81.2	90.5
Sensitivity	6.6	10.4	13.5

TABLE C-4

OCTANE NUMBERS AND COMPOSITIONS FOR 1989/1990 FBRSU FUELS

Research Octane Number	Volume Percent RMFD 371-89/90	RMFD 372-89/90	RMFD 373-89/90	Motor Octane Number	Sensitivity
80	96.5	3.5	---	73.1	6.9
82	80.5	19.5	---	74.6	7.4
84	65.5	34.5	---	75.9	8.1
85	58.0	42.0	---	76.5	8.5
86	49.5	50.5	---	77.2	8.8
87	41.0	59.0	---	77.9	9.1
88	32.5	67.5	---	78.6	9.4
89	24.5	75.5	---	78.3	9.7
90	15.5	84.5	---	80.0	10.0
91	6.5	93.5	---	80.6	10.4
92	---	98.0	2.0	81.2	10.8
93	---	90.5	9.5	81.9	11.1
94	---	83.5	16.5	82.6	11.4
95	---	75.5	24.5	83.3	11.7
96	---	67.5	32.5	84.0	12.0
97	---	59.5	40.5	84.7	12.3
98	---	51.0	49.0	85.5	12.5
99	---	42.5	57.5	86.3	12.7
100	---	34.0	66.0	87.1	12.9
101	---	25.0	75.0	87.9	13.1
102	---	15.5	84.5	88.8	13.2
103	---	5.0	95.0	89.8	13.2
103.5	---	0.0	100.0	90.3	13.2

A P P E N D I X D

PROGRAM

PROGRAM

for the

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

CRC Project No. CM-123-89

June 1989

TABLE OF CONTENTS

I. INTRODUCTION

The 1989 program of the CRC Light-Duty Octane Number Requirement Survey Group will consist of a survey of the octane number requirements of 1989 model domestic and imported vehicles. For the purposes of this program, the designation "passenger vehicles" will include passenger cars, light-duty (<8500 lb/3856 kg GVW) pickup trucks, and vans. Approximately 450 vehicles will be tested. Most of these vehicles will be sampled in proportion to their relative production or import volume, to provide data from which to estimate the distribution of octane number requirements for the 1989 model vehicle population in the United States. In addition, select models of special interest will be tested in sufficient numbers to estimate their requirement distributions.

Knocking characteristics will be investigated with three series of reference fuels. Tank fuel knock will also be evaluated. Maximum octane number requirements, whether at maximum-throttle or part-throttle, will be established for each vehicle using high sensitivity unleaded full-boiling range reference (FBRSU) fuels, average sensitivity unleaded full-boiling range reference (FBRU) fuels, and primary reference (PR) fuels. If the maximum requirement is at maximum-throttle, then part-throttle requirements are investigated with only FBRU fuels of up to, and including, four octane numbers lower than the maximum requirement. Also, minimum requirements are determined for knock-sensor equipped vehicles.

II. GEOGRAPHICAL AREAS

As in previous years, the 1989 Survey will be conducted on a nationwide basis for the US, and will include Canada. Four geographical areas have been established for test vehicle assignment purposes. Participants located in New York, New Jersey, and Pennsylvania are included in the Eastern Area; those located in Ohio, Michigan, and Kentucky comprise the East Central Area; those in Illinois, Texas, and Oklahoma comprise the West Central Area; and California participants make up the Western Area. Canadian participants are assigned to either the East or West Central Areas. Coordinators for each of the areas are as follows:

Eastern Area.....D. I. Hoel
East Central Area.....J. P. Uihlein
West Central Area.....J. B. Baker
Western Area.....T. Wusz

The area coordinators will contact their area participants periodically regarding the progress of the survey. To expedite this, it is suggested that participants send copies of all correspondence concerning the survey to the area coordinators. This program outlines the survey in broad terms. If more detailed information is desired, it is suggested that the participant contact his area coordinator.

III. VEHICLES

A total of approximately 450 vehicles will be tested in the 1989 Survey. Current experience indicates we can expect about 14 full participants and 5 partial participants. The 450 vehicle total will be divided into two groups: (1) the statistical group, sampled in proportion to US car model production or import volume, and (2) select models of special interest. Approximately 20 of each of these select models are assigned to be tested in order to provide an estimate of the octane requirement distribution of each model. Some of these 20 vehicles will be those already included in the statistical group, and the remainder will be additional vehicles added to the program.

The desired number of vehicles to be tested in each category is as follows:

Statistical Group	370
Additional Select Model Group	80
Total	450

A detailed breakdown of the specific models and the number of each model to be tested will be circulated to the participants in May 1989 after an estimate of vehicle model production has been obtained. Design specifications for select models to be tested in the 1989 Survey are shown in Table D-1. Selection of these vehicles has been based on new or modified design characteristics that might have a significant effect on octane number requirements and high sales volume which allows individual treatment without additional testing.

Wherever possible, specific vehicle assignments to individual participating laboratories will be made in a pattern which tends to minimize data bias. This will be accomplished by apportioning cars of a given model among the four geographical areas, and subsequently among the laboratories within each area, in order to minimize the effect of non-random factors on the results of the Survey.

IV. FUELS

A. Full-Boiling Range Reference Fuels

Two full-boiling range reference fuel series will be used to define the vehicle octane number requirements. The two series will be unleaded and of varying sensitivity. One series will be comparable to the average sensitivity of unleaded commercial fuels (FBRU); the other series (FBRSU) will be a minimum of two numbers higher in sensitivity than the FBRU fuels. The Research octane number (RON) range for both fuel series is 79 to 104.

These fuels will be blended in increments of two RON up to 84, and one RON above 84 from three base fuels for each series. The base fuels are compounded from normal refinery gasoline compo nents. Limiting specifications for each base fuel for both series are shown in Table D-2. These specifications apply to both the 1989 and 1990 Surveys. Supplier inspection data will be shown in Table D-3.

Research and Motor ratings will be determined for incremental blends of each fuel series by participants to provide data for establishment of blending curves. The average ratings and blending curves will appear in Tables D-4 and D-5.

B. Primary Reference Fuels

Blends of ASTM-grade isooctane and normal heptane will be prepared in two octane number increments from 76 to 82, and one octane number increments from 82 to 100.

C. Tank Gasoline

Research and Motor octane ratings will be obtained only on gasoline samples from the tank of vehicles with owner questionnaire (Attachment 1). Owner's Questionnaire should be obtained if:

a) vehicle has a regular driver; and

b) the ignition timing is within $\pm$ 2^{o} of the manufacturer's specifications.

V. TEST TECHNIQUE

All tests are to be conducted using the technique entitled, "Technique for Determination of Octane Number Requirements of Light-Duty Vehicles" (CRC Designation E-15-89). A copy of this technique is included as Attachment 2 to this program. Octane number requirement investigations are to be conducted in all vehicles under level road conditions. Any vehicle obviously in poor mechanical condition or with malfunctioning emission control devices should not be considered for test work. The vehicles must have a minimum of 6000 deposit miles (9656 km), and preferably be privately owned and operated. Data with less than 6000 miles will not be analyzed. Vehicles previously used for fuel road octane rating must not be employed in this survey.

Data should be reported on each vehicle tested, even though knock was not encountered on any of the fuels.

The order in which the fuels are to be tested is as follows:

1) Tank fuel;
2) FBRSU;
3) FBRU;
4) PR.

VI. DATA FORMS

The test results on each vehicle will be reported on data forms DFMF-11-89 and DFMF-19-89. For knock sensor-equipped vehicles, data forms should be filled out completely for maximum requirements and include vehicle information with minimum requirements. Copies of these forms will be mailed to all participants from the CRC office with instructions for their use. Additional instructions are included in the E-15-89 technique.

VII. REPORTING RESULTS

The original data forms for each vehicle tested should be submitted to William F. Biller, 68 Yorktown Road, East Brunswick, New Jersey 08816, as soon as possible, but not later than October 31, 1989.

TABLE D-1

DESIGN SPECIFICATIONS FOR 1989 SELECT MODELS

Make & Model	Engine Displ. Liters	Configuration & No. of Cylinders	Fuel System	Comp. Ratio	BHP	Knock-Sensor	VIN Engine Code	Trans. Type
GM								
Pontiac Grandam/ Oldsmobile Calais/ Buick Skylark	2.3	L-4	PFI	-	-	Yes	D	A-3
Oldsmobile Ciera/ Oldsmobile Calais/ Buick Century/ Buick Skylark	3.3	V-6	PFI	-	-	Yes	N	A-3 only for Calais/Skylark; A-3 and A-4 for Ciera/Century
Chevrolet Celebrity/ Pontiac 6000/ Pontiac Grand Prix/ Oldsmobile Ciera/ Oldsmobile Cutlass Supreme/ Buick Century/ Buick Regal	2.8	V-6	PFI	-	-	Yes	W	A-4 only for Grand Prix/Cutlass Supreme/Regal; A-3 and A-4 for Celebrity/6000/ Ciera/Century
Ford								
Probe	2.2	L-4	PFI	8.6	110	Yes	C	A-4
Thunderbird/Cougar	3.8	V-6	PFI	9.0	144	No	4	A-4
Chrysler								
Eagle Premier	3.0	V-6	PFI	9.3	150	Yes	--	A-4
Jeep	4.0	L-6	PFI	9.2	173	Yes	--	A-3

TABLE D-2

LIMITING SPECIFICATIONS FOR 1989 AND 1990 FULL-BOILING RANGE REFERENCE FUELS*

Inspection Tests	Unleaded Average Sensitivity Reference Fuels (FBRU) RMFD 368		RMFD 369	RMFD 370	Unleaded High Sensitivity Reference Fuels (FBRSU) RMFD 371	RMFD 372	RMFD 373
ASTM Distillation, °F(°C)							
IBP, Min.	90	(32.2)	90	90	90	90	90
10% Evap.	115-158	(46.1- 70.0)	115-158	115-158	115-158	115-158	115-158
30% Evap.	150-190	(65.6- 87.8)	150-190	150-190	150-190	150-190	150-190
50% Evap.	195-250	(90.6-121.1)	195-250	195-250	195-250	195-250	195-250
70% Evap.	230-300	(110.0-148.9)	230-300	230-300	230-300	230-300	230-300
90% Evap.	285-374	(140.6-190.0)	285-374	285-374	285-374	285-374	285-374
End Point, Max.	437	(225)	437	437	437	437	437
RVP, psi (KPa)	7-9	(48-62)	7-9	7-9	7-9	7-9	7-9
Lead, g/gal (g/l)	<0.03	(<0.008)	<0.03	<0.03	<0.03	<0.03	<0.03
Oxidation Stability, Minutes, Min.	1440		1440	1440	1440	1440	1440
Hydrocarbon Type, Vol. %							
Aromatics, Max.**	20		35	55	35	45	65
Olefins, Max.	20		15	10	35	25	15
Saturates	Remainder		Remainder	Remainder	Remainder	Remainder	Remainder
Octane Number							
Research	79 ± 1		91 ± 1	104 ± 1	79 ± 1	91 ± 1	104 ± 1
Sensitivity***	4.5 ± .5		8.5 ± .5	11.5 ± .5	6.5 ± .5	10.5 ± .5	13.5 ± .5
Minimum of two units sensitivity difference between corresponding fuels of each series.							
Color	Bronze		Green	Red	Yellow	Deep Purple	Light Blue

Note: All fuels to contain minimum 5 PTB of a 100% active antioxidant and 10 PTB of corrosion inhibitor. No manganese added.
Confirmation of product quality of fuel blends to be approved by a six-laboratory CRC Fuel Acceptance Panel prior to drumming.

* To be compounded from normal refinery components. Oxygenates are not to be used as fuel components.
** 1% maximum Benzene or legal.
*** Sensitivities are shown for the mean Research octane number.

TABLE D-3

SUPPLIER INSPECTION DATA FOR 1989 AND 1990 FULL-BOILING RANGE REFERENCE FUELS*

Inspection Tests	Unleaded Average Sensitivity Reference Fuels (FBRU)			Unleaded High Sensitivity Reference Fuels (FBRSU)		
	RMFD 368	RMFD 369	RMFD 370	RMFD 371	RMFD 372	RMFD 373
ASTM Distillation, °F						
IBP	91	90	90	90	97	91
10% Evap.	136	118	127	135	127	137
30% Evap.	176	152	182	174	158	190
50% Evap.	209	196	218	207	206	232
70% Evap.	233	250	248	247	280	256
90% Evap.	325	334	286	365	369	312
Endpoint	426	425	357	431	430	407
RVP, psi	7.1	8.3	7.5	8.1	7.1	7.5
Lead, g/gal	0.000	0.000	0.000	0.000	0.000	0.000
Oxidation Stability, Minutes	1440+	1440+	1440+	1440+	1440+	1440+
Hydrocarbon Type, Vol. %						
Aromatics	19.6	25.7	46.4	23.7	31.5	50.4
Olefins	10.0	15.0	3.2	29.9	21.5	3.8
Saturates	70.4	59.3	50.4	46.4	47.0	45.8
Octane Number						
Research	79.3	90.6	104.2	79.5	91.6	104.0
Sensitivity	4.7	8.3	11.5	6.6	10.5	13.5
Color	Bronze	Green	Red	Yellow	Purple	Light Blue

TABLE D-4

COMPOSITIONS AND OCTANE NUMBERS

FOR CRC 1989-90 FBRU REFERENCE FUELS

Research Octane Number	Volume Percent RMFD 368-89	RMFD 369-89	RMFD 370-89	Motor Octane Number	Sensitivity
80	91.5	8.5	--	75.2	4.8
82	75.0	25.0	--	76.7	5.3
84	59.0	41.0	--	78.1	5.9
85	51.0	49.0	--	78.7	6.3
86	42.5	57.5	--	79.4	6.6
87	34.0	66.0	--	80.0	7.0
88	25.0	75.0	--	80.7	7.3
89	15.5	84.5	--	81.3	7.7
90	5.0	95.0	--	81.9	8.1
91	--	96.5	3.5	82.6	8.4
92	--	90.0	10.0	83.3	8.7
93	--	83.5	16.5	83.9	9.1
94	--	76.5	23.5	84.5	9.5
95	--	69.5	30.5	85.2	9.8
96	--	62.5	37.5	85.9	10.1
97	--	55.0	45.0	86.6	10.4
98	--	48.0	52.0	87.3	10.7
99	--	40.5	59.5	88.0	11.0
100	--	32.5	67.5	88.8	11.2
101	--	24.0	76.0	89.6	11.4
102	--	16.0	84.0	90.4	11.6
103	--	8.0	92.0	91.4	11.6
104	--	0.0	100.0	92.6	11.4

TABLE D-5

COMPOSITIONS AND OCTANE NUMBERS

FOR CRC 1989-90 FBRSU REFERENCE FUELS

Research Octane Number	Volume Percent RMFD 371-89	RMFD 372-89	RMFD 373-89	Motor Octane Number	Sensitivity
80	96.5	3.5	--	73.1	6.9
82	80.5	19.5	--	74.6	7.4
84	65.5	34.5	--	75.9	8.1
85	58.0	42.0	--	76.5	8.5
86	49.5	50.5	--	77.2	8.8
87	41.0	59.0	--	77.9	9.1
88	32.5	67.5	--	78.6	9.4
89	24.5	75.5	--	79.3	9.7
90	15.5	84.5	--	80.0	10.0
91	6.5	93.5	--	80.6	10.4
92	--	98.0	2.0	81.2	10.8
93	--	90.5	9.5	81.9	11.1
94	--	83.5	16.5	82.6	11.4
95	--	75.5	24.5	83.3	11.7
96	--	67.5	32.5	84.0	12.0
97	--	59.5	40.5	84.7	12.3
98	--	51.0	49.0	85.5	12.5
99	--	42.5	57.5	86.3	12.7
100	--	34.0	66.0	87.1	12.9
101	--	25.0	75.0	87.9	13.1
102	--	15.5	84.5	88.8	13.2
103	--	5.0	95.0	89.8	13.2
103.5	--	0.0	100.0	90.3	13.2

Attachment 1

CRC OCTANE NUMBER REQUIREMENT SURVEY

OWNER'S QUESTIONNAIRE

OWNER:

Your vehicle is being tested for fuel octane number requirements by a Coordinating Research Council activity. To help analyze the data, we would like the person who has recently been driving the vehicle to answer the following questions:

1. What grade of unleaded fuel was purchased the last two times?

☐ Regular ☐ Mid-Grade ☐ Premium

2. Has any engine knock (ping) been encountered with the fuel that is now in the tank?

☐ Yes ☐ No

3. Did you consider the knock (ping) objectionable?

☐ Yes ☐ No

Vehicle Make _____ License No. _____

Vehicle Identification No. _____

Company Testing Vehicle _____

Attachment 2

TECHNIQUE FOR DETERMINATION OF OCTANE NUMBER REQUIREMENTS OF LIGHT-DUTY VEHICLES

(CRC Designation E-15-89)

June 1989

TECHNIQUE FOR DETERMINATION OF OCTANE NUMBER REQUIREMENTS OF LIGHT-DUTY VEHICLES

(CRC Designation E-15-89 - Including Appendix A)

A. GENERAL

The technique provides for the determination of maximum octane number requirements (and minimum octane number requirements for vehicles equipped with knock sensors), whether at maximum-throttle or part-throttle, of a vehicle in terms of borderline spark knock on two series of full-boiling range reference fuels as well as on primary reference fuels. If the maximum requirement is at maximum-throttle, then part-throttle requirements are investigated with only FBRU fuels of up to, and including, four octane numbers lower than the maximum requirement.

Knock intensity on tank fuel will be measured.

B. DEFINITION OF TERMS

The following definitions of knock, approved by the CLR and CFR Committees on June 8, 1954, have been rephrased for clarification and adaptability to current technology by the Survey Steering Panel.

1. **Spark Knock:**

   Spark knock is the noise associated with the autoignition* of a portion of the fuel-air mixture ahead of the advancing flame front. It is recurrent and repeatable in terms of audibility and fuel octane quality. This includes knock occurring when going from road load to other operating conditions (e.g., tip-in, etc.).

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* Autoignition: The spontaneous ignition and the resulting very rapid reaction of a portion or all of the fuel-air mixture. The flame speed is many, many times greater than that which follows normal spark ignition. There is no time reference for autoignition.

a. Maximum-Throttle

The throttle is depressed and held at either full-throttle or the widest throttle position that does not cause the transmission to downshift (detent) throughout the acceleration in each of the required test gears listed in D.3.d.(1)(a). The detent manifold vacuum/pressure obtainable on a given model is determined by the transmission characteristics. For manual transmissions, the throttle is depressed fully throughout the acceleration.

b. Part-Throttle

The throttle is depressed and regulated throughout the acceleration to maintain a desired, constant critical manifold vacuum/pressure as defined in D.3.d.(1)(d).

C. VEHICLE PREPARATION

The following vehicle preparation steps should be completed before any octane tests are run. Detailed procedures for each adjustment can be found in the manufacturers' shop manuals.

1. Record vehicle identification number and emission control type, Federal, Altitude, California, or Fifty-State. Fill in headings on both sheets of data form DFMF-11-89. Ford emission calibration numbers are to be recorded.

2. Inspect all vacuum lines and air pump hoses for appropriate connections. Also, check to see if PCV valve, spark advance vacuum delay controls, EGR valve, knock sensors, and heated inlet air mechanism are functioning. Engine must be warmed up for these checks.

3. Check engine idle speed and observe anti-dieseling solenoid operation. Adjust to within manufacturers' recommended specifications as specified on the underhood decal.

4. Observe and record basic spark timing at recommended engine speed. Adjust to within manufacturers' recommended setting as specified on the underhood decal.

5. Crankcase oil, radiator coolant, automatic transmission fluid, and battery fluid levels shall be maintained as recommended by the manufacturer.

6. A calibrated tachometer graduated in 100 rpm (or smaller) increments shall be used.

7. One calibrated vacuum gage, graduated in one-half inch of mercury (or smaller) increments and capable of indicating vacuum from 0-24 inches of mercury (0-81 kPa) shall be connected to the intake manifold. For vehicles with turbochargers, a compound vacuum/pressure gage should be used; the pressure side of the gage should be capable of indicating pressures up to 15 psig (103 kPa).

8. An auxiliary fuel system shall be provided to supply test fuels to the engine. Caution shall be taken to avoid placing auxiliary fuel lines in locations which promote vapor lock. If vehicles with carbureted engines have tank return fuel lines, this return line should be blocked off. Disconnect fuel tank vent line at evaporation control system canister. Instructions for the auxiliary fuel system used with fuel injection are given in Appendix A.

9. For vehicles with owner questionnaire completed, a sample of the tank gasoline shall be withdrawn for determination of Research and Motor method octane number ratings. If insufficient fuel is available, omit this step and obtain tank fuel observations as described in Item D.3.d.(2).

D. TEST PROCEDURE

1. Engine Warm-Up

a. To stabilize engine temperatures, a minimum of ten miles of warm-up is required. The test vehicle should be operated at 55-70 mph (88-113 kph) in top gear with a minimum of full-throttle operation.

b. During the warm-up period, the general mechanical condition of the vehicle should be checked to insure satisfactory and safe operation during test work.

2. Fuel Changeover

To eliminate contamination of the new fuel with residual amounts of the previous fuel, fuel-injected systems should be flushed once with new fuel and carburetted systems should be flushed twice. Fuel handling

procedures for vehicles equipped with fuel injection systems are explained in Appendix A.

After fuel changeover, make one maximum-throttle acceleration before beginning Vehicle Rating Procedure.

3. Details of Observations

a. Operating Conditions

All octane number requirements will be determined under level road acceleration conditions.

Tests will be conducted on moderately dry days, preferably at ambient temperatures between 60°F (15.5°C) and 90°F (32.2°C). Tests should not be conducted during periods of high humidity such as prevail when rain is threatening or during or immediately after a rain storm. Laboratories with control capabilities should target for 70°F (21°C) air temperature and 50 grains of water per pound (7.14 gm/kg) of dry air whenever possible.

Air-conditioned vehicles will be tested with air conditioner turned ON. (Normal setting, comfortable temperature, low fan. Air conditioner will be ON at all times.

b. Order of Fuel Testing

1) Tank
2) FBRSU
3) FBRU
4) Primary

c. Determination of Knock Intensity

Maximum octane requirements will be established by evaluating the occurrence of knock in terms of knock intensity: "N" for none, "B" for borderline, and "A" for above borderline. Establishment of representative knock intensity for a given fuel will be accomplished with a maximum of three (3) rated accelerations. Coast-down time between the end of one acceleration and the beginning of the next should be approximately twenty (20) seconds. As defined below, the first two duplicating accelerations are sufficient with "N" and "B" intensity.

Acceleration Number			Representative Rating
1	2	3	
N	N	-	N
N	B	N	N
N	B	B	B
B	N	B	B
B	B	-	B
B	A	-	A
A	-	-	A

All accelerations will be discontinued when "A" knock intensity is experienced, and testing continued with a higher octane number fuel in that series. If "A' knock is experienced at initiation of accel eration, as limited by transmission characteristics, this speed will be considered the speed of maximum knock. Otherwise, the midpoint between knock-in and knock-out will be considered the speed of maximum knock. When establishing knock-in and knock-out, back off on the throttle between points to eliminate "A" knock.

Minimum octane number requirements for vehicles equipped with knock sensors will be established in a similar manner except that when "A" knock intensity is encountered, subsequent accelerations will be made with a given fuel until duplicate "A" ratings are obtained as measured above.

d. Determination of Octane Requirements

Tests should be run to 70 mph (113 kph). If required to termi nate at lower speed, termination speed should be noted on data sheet.

(1) Vehicle Operating Procedure

Accelerations will be run up to 70 mph; however, engine speed should not exceed 4,000 rpm or 750 rpm over peak torque as defined in Automotive News, whichever is higher.

(a) Establishment of Automatic Transmission Characteristics

Determine the minimum obtainable road speed, and obtain the transmission downshift characteristics of engine rpm and manifold vacuum/pressure from minimum speed at 25, 35, 45, 55, and 65 mph (40, 56, 72, 88 and 104 kph) as applicable (as obtainable in each gear), by movement of the throttle through the detent, i.e., downshift, throttle position. These characteristics are to be determined for each of the gears specified in the table below. For transmissions with converter clutches, determine the minimum road speed for clutch applica tion. At this initial speed and at 10 mph (16 kph), increments up to about 60 mph (97 kph) determine mini mum vacuums (pressures) for application. Record all road speed/engine rpm/vacuum or pressure measurements from above on data sheet.

Do not use brakes, turn signals or hazard flashers during accelerations as these may affect electronic engine controls.

The selection of required test gears, and test gear/ converter clutch combinations (if applicable) for various types of transmissions are shown in Table T-I. Transmissions not explicitly described should be tested in a manner as similar as possible to those listed. Automatic transmission vehicles should be tested with the gear selector in the top forward gear, normally found to the right or below neutral; top gear should not be locked out. Transmissions equipped with electronic overdrive should be operated in overdrive. Transmis sions equipped with power/normal selection should be operated in the normal position.

TABLE T-I

TRANSMISSION GEAR SELECTION

AUTOMATICS

Check for critical condition:

Place the selector in the top forward gear, normally found to the right or below neutral; top gear should not be locked out. Transmissions equipped with electronic overdrive should be operated in overdrive. Transmissions equipped with power/normal selection should be operated in the normal position.

Type	Gears to be Tested
GM 4-speed	4th gear, converter clutch engaged
	3rd gear, converter clutch engaged
	3rd gear, converter clutch disengaged
	2nd gear, converter clutch disengaged
GM 3-speed/ Chrysler 3-speed with converter clutch	3rd gear, converter clutch engaged
	3rd gear, converter clutch disengaged
	2nd gear, converter clutch disengaged
Ford Front-Wheel Drive:	
4-speed overdrive	4th gear, converter clutch engaged
	4th gear, converter clutch disengaged
	3rd gear, converter clutch engaged, if applicable
	3rd gear, converter clutch disengaged
	2nd gear
Ford Rear-Wheel Drive:	
4-speed overdrive	4th gear, converter clutch engaged, if applicable
	4th gear, converter clutch disengaged
	3rd gear, converter clutch engaged, if applicable
	3rd gear, converter clutch disengaged
	2nd gear
Other 3-speed	3rd gear
	2nd gear

MANUALS

5-speed	4th and 3rd gears
4-speed	4th and 3rd gears
3-speed	3rd and 2nd gears

(b) Maximum-Throttle Accelerations - Automatic Transmissions

For maximum-throttle accelerations in each of the gears and gear/converter clutch combinations specified above, accelerate at the detent/application condition according to the speed versus vacuum/pressure profiles determined in (a) from the minimum obtainable speed to maximum test speed. If the transmission downshifts, abort and start the acceleration again. Start with the highest gear or gear/clutch combination and proceed in descending order.

(c) Maximum-Throttle Accelerations - Manual Transmissions

Select the highest gear as specified in the table above. Start at the lowest speed from which the vehicle will accelerate smoothly, but not less than 25 mph (40 kph) and depress the throttle fully throughout the acceleration up to maximum test speed.

Select the next lower gear specified in the table above and accelerate at full throttle from the minimum speed from which the vehicle will accelerate smoothly up to maximum test speed.

(d) Part-Throttle Accelerations for Both Automatic and Manual Transmissions

Select the highest gear as specified in Table T-I for manual transmissions. Select the two highest gears as specified in Table T-I for automatic transmissions. For example, on a four-speed automatic transmission, check both fourth locked and unlocked and third locked and unlocked; on a three-speed automatic transmission, check third locked and unlocked and second. For auto matic transmissions with converter clutches use the highest gear up to the minimum vehicle speed at which the converter clutch will engage, and the highest gear/converter clutch combination above this minimum speed, to obtain the critical part-throttle vacuum or pressure. To obtain the critical part-throttle vacuum/pressure, first operate at constant speed road load, at 25, 35, 45, 55, and 65 mph (40, 56, 72, 88, and 105 kph) incremental speeds if obtainable in the specified gear. This is called "fanning". At each speed, move the throttle in approximately 3 seconds from the road-load vacuum to the positions described below for naturally aspirated and turbocharged engines:

1. for naturally aspirated vehicles, one inch Hg (3.34 kPa) above:

   a. full-throttle vacuum for manual transmissions;

   b. detent vacuum for automatic transmissions without converter clutches;

   c. the minimum vacuum at which the converter clutch disengages for so-equipped automatic transmissions.

2. for turbocharged vehicles, one inch Hg or 0.5 psig (3.34 kPa) below:

   a. full-throttle maximum boost for manual transmissions;

   b. maximum boost at detent for automatic transmissions without converter clutches;

   c. maximum boost or 0.5 psig (3.34 kPa) above the minimum vacuum at which the converter clutch disengages for so-equipped automatic transmis sions.

Use of vehicle brakes must be avoided.

If knocking occurs within any of the vacuum/pressure ranges, establish the manifold vacuum/pressure which gives maximum knock intensity on each fuel series. This is the critical vacuum/pressure to be used for all subsequent constant-vacuum/pressure part-throttle ac celerations from the minimum obtainable speed in the test gear to 70 mph (113 kph), or until the vehicle ceases to accelerate. A critical vacuum/pressure should be determined for each reference fuel series.

If knock is encountered during the fanning procedure but during the constant-vacuum/pressure part-throttle accelerations, it should be recorded as tip-in.

(2) Tank Fuel Observations

Investigate for maximum-throttle and part-throttle knock as detailed in Item 3d(1), only if a customer questionnaire has been completed. Define maximum knock intensity as per Item 3c. Record maximum knock intensity, speed of maximum knock intensity, and manifold vacuum/pressure at each operating condition. Tank fuel rating should be terminated if a knock is encountered at any time.

(3) Vehicle Rating Procedure

All initial accelerations should be started from minimum obtainable gear/converter clutch combination at constant level road-load conditions. Knock rating should be performed while in a normal upright seated position with floor mats in place.

Step 1 - After Tank Fuel Observations, use a fuel estimated to give borderline knock in a given fuel series and investigate for incidence of knock under conditions as described in D.3.d.(1)(b) above, and D.3.d.(1) (c) above, whichever is applicable.

Step 2 - If no knock occurs, go to a lower octane number blend in that series and repeat Step 1.

Step 3 - If knock occurs at one or more of the operating conditions in Step 1, continue investigation at the critical condition(s) with higher octane blends until highest octane fuel giving knock is determined within one octane number or one blend (the next higher fuel giving no knock). Record maximum knock intensity on all fuels. Record speed of maximum knock intensity and manifold vacuum/pressure on highest octane fuel that knocks.

Step 4 - Using the highest octane blend that knocked in Step 3, investigate for incidence of part-throttle knock as described in D.3.d.(1)(d). If knock occurs, continue investigation at critical vacuum/pressure until requirement is defined. Record maximum knock intensity and critical manifold vacuum/pressure on all fuels, and speed of maximum knock intensity on highest octane fuel that knocks.

Step 5 - With FBRU fuel only, if no knock occurs in Step 4, go to a lower octane number blend and repeat Step 4. Discontinue part-throttle investigation if knock is not observed with a fuel four octane numbers lower than the highest borderline knock determined in Step 3.

Step 6 - With FBRU fuel only, for knock-sensor equipped vehicles after determination of maximum requirement, continue with lower octane blends until the lowest octane fuel giving borderline knock is determined (the next lowest fuel giving above borderline knock).

The rating procedure is given in arrow diagram form on page 26 for maximum requirement, and on page 27 for minimum requirement, for knock sensor-equipped cars.

E. INTERPRETATION OF DATA

The data will be recorded on data sheets DFMF-11-89 and DFMF-19-89. Data Form DFMF-11-89 has provisions for recording both the maximum and minimum requirements of knock-sensor equipped vehicles on the same sheet. Additional data sheets for recording run data may be appended to DFMF-11-89 as needed. Octane requirements for all reference fuels shall be determined as follows:

1. If the knock intensity of the highest reference fuel giving knock is borderline, the requirement shall be reported as the octane number of that fuel.

2. If the knock intensity of the highest fuel giving knock is above borderline, the requirement shall be reported as the mid-point between the octane number of the fuel giving knock and that of the next higher fuel.

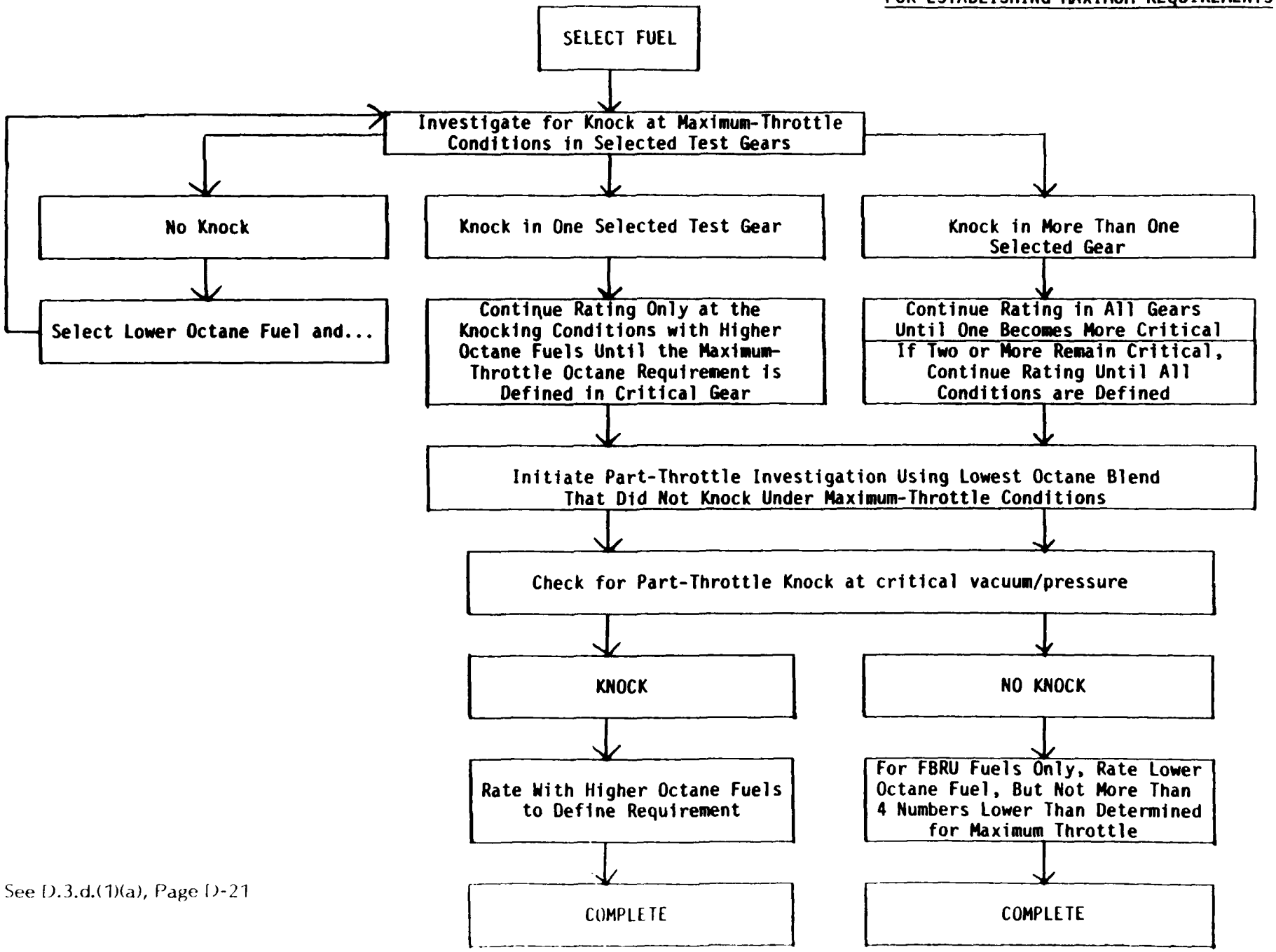
3. If the octane requirement in high gear is equal to the requirement in a lower gear, report the highest gear data.

4. For part-throttle requirements, report the data from the critical manifold vacuum/pressure observations.

5. For knock-sensor equipped vehicles, report the highest and lowest fuel giving borderline knock. If the knock intensity with the lowest fuel giving knock is above borderline and the next highest fuel is no knock, then the minimum requirement is the mid-point between the two.

Record data on all fuels tested, even though knock was not encountered. The octane number requirement summary block on the first sheet of DFMF-11-89 provides space for both the maximum and the minimum requirements of knock-sensor equipped vehicles. When transferring data to the summary block, record maximum-throttle and part-throttle octane number requirements in the appropriate blocks. The higher of the two will be selected by the computer as the maximum octane number requirement. If both maximum-throttle and part-throttle requirements are equal, then the computer will select the part-throttle requirement as the maximum octane number requirement. Use proper letter designation (see footnotes on data sheet) to designate: (1) requirements outside of the reference fuel limits; (2) FBRU part-throttle requirement more than four numbers below maximum; and (3) all other cases for which the octane number requirement has not been determined. Note that in the case of a converter-clutch equipped vehicle, test gear numbers should indicate whether the converter clutch was locked or unlocked. Note also that in the case of turbo-equipped vehicles, a manifold pressure above atmospheric is indicated as a negative number in units of psig.

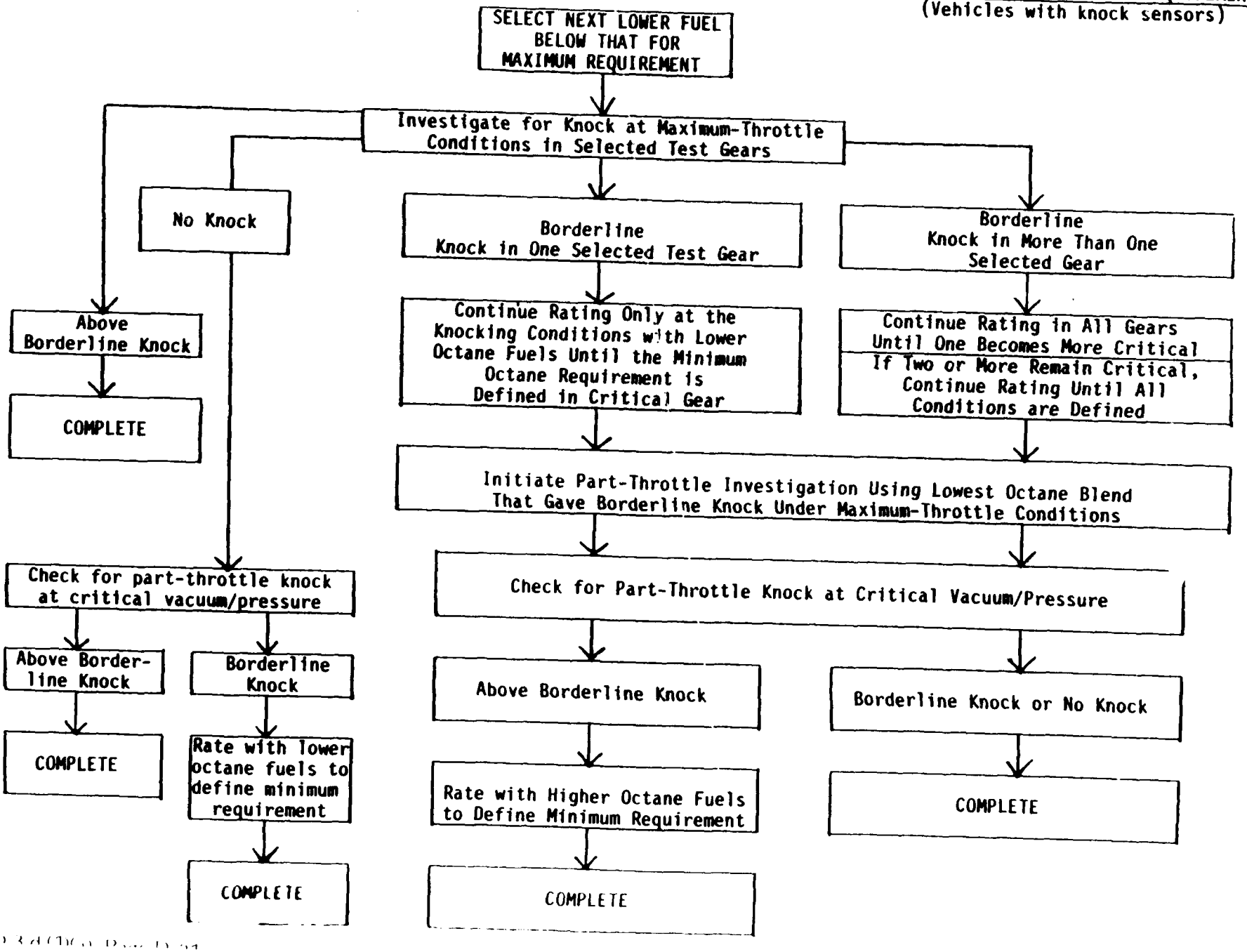
It is important that the vehicle identification number (VIN) of each vehicle tested be recorded on all data sheets to provide a means of cross-indexing.



* See D.3.d.(1)(a), Page D-21

FOR FBRU FUELS ONLY:

FOR ESTABLISHING MINIMUM REQUIREMENTS
(Vehicles with knock sensors)



* See D.3.6(b) Part D-27

APPENDIX A

to the

CRC E-15-89 TECHNIQUE

PROCEDURE FOR SETTING UP VEHICLES WITH FUEL INJECTION

APPENDIX A

PROCEDURE FOR SETTING UP VEHICLES AND HANDLING REFERENCE FUELS: VEHICLES EQUIPPED WITH FUEL INJECTION

1. To run octane requirements on fuel-injected vehicles, it is necessary to install an external fuel supply line with auxiliary electric fuel pump from the reference fuel can to the vehicle fuel system and an external return line back to the reference fuel can.

2. There are two types of fuel injection systems: throttle-body injection, and multi-port injection. As a general description, the systems will contain the following parts:

   Fuel Tank
   High- or Low-Pressure In-Tank Fuel Pump
   Fuel Supply Line(s)
   In-Line Filter(s)
   High-Pressure Chassis-Mounted Pump (not required for all vehicles)
   Fuel Rail (to supply multiple injectors on port fuel injection)
   Fuel-Pressure Regulator (integral on throttle-body, on fuel rail with multi-port injection; controls pressure at the injectors).

   Depending upon the vehicle's specific fuel system and/or tester's preference, installation of the required auxiliary equipment can be accomplished in a variety of ways.

3. The auxiliary fuel supply line may be installed anywhere between the fuel tank and the inlet at the throttle-body or fuel rail. The auxiliary fuel return line may be installed anywhere between the fuel- pressure regulator outlet and the tank.

4. After connections have been broken, the fuel lines on the fuel tank side should be capped and the vehicle's pump(s) disconnected or disarmed. Alternately, an additional fuel line can be looped between the supply and return lines and the vehicle pump(s) allowed to circulate fuel directly back to the fuel tank. Caution should be exercised if this alternate technique is used. A high pressure will build up in the tank due to the large amount of vapors generated.

   The auxiliary fuel supply system must be capable of supplying fuel at a pressure slightly higher than the maximum fuel pressure required (at wide-open-throttle on normally aspirated engines or at maximum manifold boost pressure on turbocharged or supercharged engines) by the particular vehicle being tested. This is to overcome any line losses and thus insure accurate results. This may be accomplished by using an adjustable high-pressure pump, or by using a low-pressure pump to supply fuel to the chassis-mounted high-pressure pump if the testing lab chooses to keep it in the system. A fuel filter may be required between the auxil

iary pump and the reference fuel can to protect the pump. The fuel return line should be connected to a tee at the auxiliary pump inlet. The reference fuel can should be vented to outside the vehicle.

It is possible to use three-way valves in the fuel line between the fuel pump and the fuel tank and between the return line and the fuel tank. When used, the operator must change the return line valve to the auxiliary fuel system while the engine is shut down, to avoid building up excessive pressure in the return line which could damage both the fuel-pressure regulator and injection pump.

5. When changing from one reference fuel can to another, the following steps should be followed:

   a. Disconnect fuel inlet line from reference fuel can and run engine a short time; do not run out of fuel since this will introduce air into the fuel injection system and excessive cranking will be required to restart the engine.

   b. With the engine shut off, disconnect the fuel return line from the auxiliary pump inlet and connect it to a slop can. Connect the fuel supply line to the new reference fuel can and run the engine long enough to purge the old reference fuel from the system. The time required will be dependent upon length of added fuel lines, but it will be approximately 30-60 seconds; approximately 1-2 quarts of fuel will be discarded to slop.(1)

   c. With the engine off, connect the fuel return line to the auxiliary pump inlet. The vehicle is then ready to be tested.

   d. When changing to the next reference fuel, it is necessary to repeat Steps a, b, and c.

CAUTION

Fuel supply lines remain pressurized long after the engine is shut off; be sure to relieve the pressure before disconnecting fuel lines.

Use fuel lines designed for high pressure. They should be rated for at least 250 psi working pressure and for 1000 psi burst pressure.

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(1) It is critical to circulate an adequate amount of fuel to the slop can to prevent reference fuel contamination.

CAUTION - (Continued)

The engine and auxiliary fuel pumps should be shut off while changing from auxiliary to tank fuels.

Purging procedures should be followed strictly to preclude reference fuel contamination or discarding more fuel than is required.

Vehicle pump(s) may be disarmed by use of the inertia switch if so equipped. The voltage supplied to the inertia switch may then be used to power the auxiliary pump. When making these electrical connections, do not "splice" into the wire; instead, connect the wire lead to the connector.

Do not disarm the vehicle fuel pump by removing the fuse, since other accessories may be connected to the same circuit; instead, disconnect the fuel pump electrical lead.

Auxiliary fuel return lines should be of a size large enough to prevent a build-up of back pressure which could prevent the proper operation of the pressure regulator.

Use of the "rolled edge" style hose clamps, such as those made by Chrysler, is recommended to prevent damage to fuel lines.

Note: Diagnostic scanners should not be used while knock testing.

A P P E N D I X E

1989 OCTANE NUMBER REQUIREMENT SURVEY DATA

G L O S S A R Y

(For Appendix E Only)

Emission Certification (EMCT):	A	Altitude
	C	California
	F	Federal
	E	Everything
Knock Sensor (KS):	H	Maximum Requirement
	L	Minimum-Borderline Requirement
	N	No
Air Conditioner (AIR):	Y	Yes
	N	No
Spark Advance:	+	Before Top Center
	-	After Top Center
Test Fuel:	1	Tank Fuel
	2	FBRSU
	3	FBRU
	4	PR
Octane Number Requirements: (expressed as Research ON)	L	Less than lowest available ON for FBRU and FBRSU fuels and less than 76 for PR fuels
	H	Higher than highest available ON for FBRU and FBRSU fuels and higher than 100 ON for PR fuels
	F	Part-throttle requirement greater than four numbers below maximum-throttle requirement
Throttle (THR):	M	Maximum
	P	Part
Gear:	1-5	Manual and Automatic
	U	Not tested in lockup (torque converter not engaged)
	L	Tested in lockup (torgue converter engaged)
Manifold Vacuum (VAC):	Inches Hg, positive for vacuum, negative (-) for pressure	
Owner-Reported Knock (OWKNK):	Y	Yes, Not Objectionable
	O	Objectionable
	N	No
Rater-Reported Noise Intensity (KNINT)	N	None
	B	Borderline
	A	Above Borderline

1994 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION													WEATHER		OCTANE NUMBER REQUIREMENT DATA												TANK FUEL INFORMATION							
															MAXIMUM					PART-THROTTLE							RATED							
OBS NO	MODEL CODE	ENGINE CYL	ENGINE DISP	SPARK ADVANCE				ODOM MILES	AMB TMP	BAROM	HUM	ENGINE SPEED	OCT NO	A P	PPM	AAC	OCT NO	A P	PPM	AAC	CONSUMPTION		OCTANE NO										
				MAN	AUTO	AS RCD	AS TST																MOTR	T	R	P	PPM	AAC						
16-19	CHEVROLET	8	5.7	-	X			12480	70	30.09	10	0	89.0	AL	0200	0.4	89.0	DL	0000	0.0	N	88.6	87.6	N									
				-								1	87.0	DL	4400	0.7																	
				-								4	87.0	AL	0000	0.4																	
				-								0	88.0	AL	2000	0.4	88.0	DL	0000	0.0													
				-								2																					
				-								4																					
20-23	CHEVROLET	8	5.7	-	X			7820	69	30.10	25	0	90.0	AL	1800	0.6	88.0	AL	0000	0.0													
				-								1	87.0	DL	0600	0.6																	
				-								4	88.0	AL	1950	0.6																	
				-								0	90.0	AL	1800	0.6																	
				-								2	89.5	AL	2050	0.6																	
				-								4	88.0	AL	1950	0.6																	
24-	CHEVROLET	8	5.7	-	X			15700	68	30.00	34	0	94.0	DL	2650	0.6	90.0	DL	0000	4.0	N	88.6	88.7	N									
				-								1	95.0	DL	1300	0.6																	
				-								4	90.5	DL	0750	0.6																	
				-								0	94.0	DL	2650	0.6																	
				-								1	94.0	DL	0750	0.6																	
				-								4	90.5	DL	0750	0.6																	
28-31	CHEVROLET	8	5.7	-	X			9784	70	30.10	60	0	95.0	DL	2700	1.0	94.0	DL	0000	0.0							90.4	B	P	20.0	401	1.1		
				-								1	93.0	AL	1600	0.6	93.0	AL	1800	0.6													
				-								4	94.0	AL	1700	0.6	94.0	AL	1800	0.0													
				-								0	90.0	DL	0000	1.0	90.0	DL	2700	0.0													
				-								2	97.0	AL	1900	0.6	97.0	AL	2000	2.0													
				-								4	92.0	AL	1700	0.6	92.0	AL	1900	0.0													
32-35	CHEVROLET	8	5.0	-	X			9267	78	30.00	29	79	0	87.0	DL	0800	0.0	85.0	AL	1750	0.0													
				-								1	89.0	DL	0800	0.0	F																
				-								4	85.0	DL	1900	0.0	F																
				-								0	87.0	DL	0800	0.0	85.0	AL	1750	0.0													
				-								2	89.0	DL	0800	0.0	F																
				-								4	85.0	DL	1900	0.0	F																
36-39	CHEVROLET	8	5.0	-	X			7118	66	29.94	115	0	88.0	DL	0200	0.0	F																
				-								2	85.0	DL	0200	0.0	F																
				-								4	84.0	DL	1900	0.0	F																
				-								0	88.0	DL	0200	0.0	F																
				-								2	84.0	DL	0200	0.0	F																
				-								4	87.0	DL	1900	0.0	F																

1983 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	VEHICLE DESCRIPTION: MODEL CODE	ENGINE TYPE	MAN TRANS	SPARK ADVANCE: AUTO	SPARK ADVANCE: MAN	ODOM MILES	AMB TMP	BAROM PRS	NUM LVL	MAXIMUM: OCT NO	MAXIMUM: SENS	MAXIMUM: RPM	MAXIMUM: LOAD	PART-THROTTLE: OCT NO	PART-THROTTLE: SENS	PART-THROTTLE: RPM	PART-THROTTLE: LOAD	TANK FUEL INFORMATION: OCTANE RATER: OCT NO	TANK FUEL INFORMATION: OCTANE RATER: RES	TANK FUEL INFORMATION: OCTANE RATER: MOTR	TANK FUEL INFORMATION: SENSITIVITY	TANK FUEL INFORMATION: DRIVEABILITY	TANK FUEL INFORMATION: VAPOR PRESSURE	TANK FUEL INFORMATION: DISTILLATION	TANK FUEL INFORMATION: AROMATICS
16-11	CHEVROLET	E	M	3.0		77161	88	29.34	115	93.0	DU	2300	0.6												
									2	94.0	DU	2800	0.6	F										
									4	99.0	4U	1700	0.6	F										
									1	90.0	DU	2300	0.6	F										
									2	92.0	DU	1700	0.6	F										
									4	98.0	4U	1900	0.6	F										
16-12	CHEVROLET	E	M	3.0		12688	79	29.06	108	93.0	4U	1550	0.0	88.0	4U	1800	1.0								
									2	90.5	DU	2000	0.0	F										
									4	97.5	DU	2650	0.0	F										
									1	93.0	4U	1550	0.0	88.0	4U	1800	1.0								
									2	90.5	DU	2000	0.0	F										
									4	97.5	DU	2650	0.0	F										
66-08	CHEVROLET	F	M	3.0		9761	74	29.80	84	91.0	4U	1300	1.0	80.0	4U	1900	4.0								
									2	90.5	DU	1700	1.0												
									4	96.0	4U	1900	1.0												
									1	90.0	4U	1550	1.0												
									2																
									4																
46-07	CHEVROLET	E	M	3.0		8620	84	29.60	97	97.0	4U	1625	1.0	87.0	4U	1600	0.0								
									2	93.0	4U	1825	1.0												
									4	94.0	4U	1550	1.0	84.0	4U	1675	0.0								
									1	96.0	4U	1825	1.0	86.0	4U	1800	0.0								
									2	97.0	4U	1625	1.0												
									4	94.0	4U	1550	1.0	84.0	4U	1675	0.0								
16-10	CHEVROLET	E	A	3.8		33176	76	29.97	118	95.5	DU	2000	0.0	80.0	DU	0000	1.0								
									2	93.0	DU	2200	0.0	F										
									4	94.0	DU	2400	0.0	F										
16-01	CHEVROLET	A	A	3.8	+	+12	+12	19405	76	29.80	40	93.0	DU	2000	1.0	86.0	DU	2225	4.5			N			
									2	90.0	DU	2400	1.0												
									4	97.0	DU	2800	1.0												
16-07	CHEVROLET	F	A	3.8	+	+12	+12	6826	71	30.15	60	96.5	DU	2800	1.0	F						N			
									2	93.0	DU	2475	1.4												
									4	95.0	DU	2000	1.7												
47-02	CHEVROLET	F	A	3.8	N	+12	+12	8068	71	30.10	80	97.5	DU	2400	0.0	84.0	DU	0000	1.0						
									2	95.5	DU	2700	0.0												
									4	96.0	DU	3000	0.0												

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	EMOT	TS	C.I.R.	AIR	SPARK ADVANCE AS RCD	SPARK ADVANCE AS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	MAXIMUM OCT NO	MAXIMUM GEAR	MAXIMUM RPM	MAXIMUM VAC	PART-THROTTLE OCT NO	PART-THROTTLE GEAR	PART-THROTTLE RPM	PART-THROTTLE VAC	OWNR	OCT NO RES	OCT NO MOTR	KNOCK	TMP	RATER GEAR	RATER RPM	RATER VAC
05-00	010P00*T00A3	E	N	3.5	Y			9307	30	29.36	115	0	87.0	3L	2000	0.3	89.0	3U	2200	3.5								
												2	89.0	3L	2100	0.5	F											
												4	85.0	3L	2200	0.5	F											
07-19	010PK2*T05A0	F	N	3.3	Y	+12	+12	5160	70	30.06	53	0	94.0	3U	2550	0.0	F				.			N				
												2	95.0	3U	2550	0.0												
												4	93.0	3U	2600	0.0												
05-15	010AK0*T05A0	F	N	3.3	Y	+12	+12	5745	59	30.09	46	0	95.0	3U	2300	1.0	90.0	3U	2700	0.0	N	95.0	84.9	N				
												2	87.0	3U	2400	1.0												
												4	94.0	3U	2300	1.0												
65-05	010AU0TP05M5	F	-	7.5	Y	+12	+11	4625	66	29.75	60	0	92.5	D	3700	+10.0	90.0	4	2800	70.0								
			H									1	93.0	D	3700	+10.0												
			-									4	90.5	D	3700	+10.0												
			-									0	90.5	D	3700	+10.0												
			-									1																
			-									4																
09-22	010000*P00A4	F	N	3.3	Y	+12	+12	9360	70	29.51	50	0	90.0	2U	2000	0.0	F							N				
												1	90.5	D	1500	0.0												
												4	89.0	2U	1900	0.0												
09-01	010002*P00A4	F	N	3.3	Y	+12	+12	9305	70	29.60	50	0	86.0	3U	2100	0.0	84.5	4U	1500	4.5				N				
												2	88.5	3U	2000	0.0												
												4	84.0	3U	2200	0.5												
09-12	010000*P00A4	F	N	3.3	Y	+12	+12	15095	70	29.57	50	0	89.0	3U	2000	0.7	85.0	3U	2400	2.5				N				
												2	89.0	3U	2000	0.7												
												4	86.0	3U	2000	0.7												
05-14	010GK2*T25A3	E	N	3.3	Y			8278	61	30.27	60	0	88.0	3U	2300	1.5	85.0	3U	2500	1.5	N	90.5	84.0	N				
												2	87.0	3U	2300	0.5	F											
												4	85.0	2U	2700	0.5	F											
41-01	010K00*T00A3	F	N	3.5	Y	+7	+12	26546	75	29.93	61	0	90.0	3U	2000	0.5						93.2		N				
												1	90.0	3U	2100	0.5												
												4	90.0	3U	2000	0.5												
09-20	010P02*T00A3	F	N	3.5	Y	+10	+12	15264	70	29.48	50	0	87.0	3U	2400	0.5	89.0	3U	2700	1.5				N				
												2	87.0	3U	2700	0.5												
												4	87.0	3U	2500	0.5												
15-0[illegible]	014002*P00A4	F	N	3.3	Y	+12	+12	12824	78	29.35	57	0	82.0	3U	2700	1.5	L							N				
												1	85.0	3U	2300	1.5												
												4	91.0	3U	2650	1.5												

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	S	C.R.	SPARK ADVANCE: A I R	AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	MAXIMUM: F L	OCT NO	G E A R	RPM	VAC	PART-THROTTLE: G E A R	OCT NO	G E A R	RPM	VAC	TANK FUEL INFORMATION: C W N	OCT NO	RATED: A N I T	G E A R	RPM	AC
28-01	C14CCIxP0CA4	E	N	8.3	Y			11633	30	29.36	115	3	87.0	3L	0000	0.0		85.0	3L	0000	1.0						
												2	87.0	2U	2300	0.0	P										
												4	86.0	3U	2350	0.0	P										
28-02	C14J4IxT1BA0	F	N	8.9	+	+10	+10	7605	78	29.66	102	3	88.0	3U	2550	0.6		86.0	3U	2550	1.6						
												2	88.0	3U	2650	0.6											
												4	87.0	3U	2550	0.6											
28-03	C14J0IxP0BA0	E	-	7.8	+			7774	80	28.80	86	3	90.0	2	1700	-5.0		88.0	2	1800	-4.0						
			-									2	91.0	2	2300	-5.0	P										
			-									4	89.0	2	1800	-5.0	P										
			-									3	89.0	2	1500	-5.0		87.0	2	1800	-4.0						
			-									2	89.0	2	1900	-5.0	P										
			-									4	88.0	2	1800	-5.0	P										
28-04	C14MPIxC0CA0	E	-	8.0	+			16023	81	28.27	82	3	84.5	3L	1500	0.6		87.0	3L	2000	4.0						
			-									2	86.0	3L	1600	0.6		101.0	3L	2100	4.5						
			-									4	90.5	3U	1800	1.6		85.0	3L	2000	4.0						
			-									3	84.5	3L	1500	0.6		87.0	3L	2000	4.0						
			-									2	86.0	3L	1600	0.6		100.0	3L	2000	4.0						
			-									4	90.5	3U	1800	1.6		84.0	3L	2000	4.0						
28-05	C21B4IxP1CA0	F	N	8.7	+			8184	70	29.09	60	3	-					-				N	87.0	87.0	N			
												2	-					-										
												4	-					-										
28-06	C21E3IxT19M5	F	N	9.0	+	+10	+10	15161	70	30.21	75	3	93.0	4	2000	0.4		91.0	4	1600	0.4	N	93.0	87.0	N			
												2	91.0	4	2000	0.4		91.0	4	2000	2.4						
												4	89.0	4	2000	0.4		93.0	4	1800	0.4						
28-07	C21E3IxT19A3	F	N	9.0	+	+10	+10	17830	76	29.62	91	3	90.0	3	1800	1.0		91.0	3	1650	0.0				B	M	3	1800	1.0
												2	93.0	3	2000	1.0											
												4	92.0	3	1800	1.0											
28-08	C21E3IxT19A3	F	N	9.0	+	+10	+10	12172	76	29.69	85	3	90.0	3	1700	1.0		86.0	3	1650	0.6				N			
												2	91.0	3	1750	1.0											
												4	89.0	3	1700	1.0											
28-09	C21E3IxT19A3	F	N	9.0	+	+10	+10	10767	70	29.04	60	3	91.0	2	1700	1.0		90.0	2	1600	0.6				B	M	2	1700	1.0
												2	93.0	2	1850	1.0											
												4	90.0	3	1600	1.0											
28-10	C21E3IxT19A3	F	N	9.0	+			14160	69	29.02	70	3	94.5	3	2000	1.0		93.0	3	2000	0.0							
												2	95.5	3	2200	1.0											
												4	95.0	3	2200	1.0											

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: ENGINE TYPE	CYL	DISP.	SPARK ADVANCE: FUEL SYS	AS REC	AS TST	ODOM MILES	WEATHER: AMB TMP	BAROM	HUM	MAXIMUM: FUEL	OCT NO	GRADE	RPM	ADJ	PART-THROTTLE: FUEL	OCT NO	GRADE	RPM	ADJ	TANK FUEL INFORMATION: OCTANE NO	VAPOR LOCK PRESS	WATER: PRESENT	GRADE	RPM	ADJ
47-03	CC*E3DX**1943	C	N	3.0	*	+*C	+*C	*4000	*C	29.27	60	3	94.0	3	*750	0.4		93.0	3	*500	6.0						
												2	95.0	3	*750	0.4											
												4	93.0	3	*650	0.4											
40-01	CC*E3DX**1940	F	N	3.0	*	+*C	+*C	**990	*7	30.69	*05	3	95.5	3	*600	0.0		93.5	3	*825	0.0						
												2	94.5	2	2*00	0.0											
												4	93.5	3	*500	0.0		90.5	3	*850	*0.0						
22-04	CC*E3JX*P*3M5	F	N	3.0	*	+*C	+*C	2*600	*C	30.00	51	3						91.0	4	2350	2.0		91.3	88.0	A	P	4	0000	0.0
												2						90.0	4	2650	3.0								
												4						89.0	4	2400	2.0								
47-09	CC*P03X*P22M5	F	N	3.6	*	*	*	6	*1397	*4	29.96	64	3	91.0	3	2000	0.4					N	90.6	90.0	B	M	4	0*00	0.5
												2	92.0	3	2*00	0.4												
												4	9*.0	3	*800	0.4												
27-07	CC*P03X*P22M5	F	N	3.6	*	+	6	+	6	*0826	89	30.60	50	3	87.0	3	4050	0.0					N			N				
												2	88.0	3	3850	0.0												
												4	86.0	4	3950	0.0												
27-13	CC*P03X*P22M5	F	N	3.6	*					8*47		29.84	0	3	85.0	4	2900			F			N	91.7	88.0	N				
												2	85.0	4	3300														
												4	80.0	4	3900														
26-11	CC*P03X*P22A4	F	N	3.6	*	+	6	+	6	*5*00	*0	30.47	60	3	90.0	3U	1500	*.0		F						N				
												2	89.0	3U	1600	*.0												
												4	88.0	3U	1*00	*.0												
29-09	CC*P03X*P22A4	F	N	3.6	*	+	6	+	6	*0*9	*0	29.*0	61	3	88.0	4U	2*00	0.0		F						N				
												2	86.5	3U	2200	0.0												
												4	85.0	3U	2200	0.0												
47-07	CC*P03X*P22A4	C	N	3.6	*	+	6	+	6	**659	*5	30.02	53	3	97.0	4U	2000	*.0								B	M	3U	0000	0.0
												2	90.0	4U	2200	*.0												
												4	90.0	4U	2050	*.0												
29-10	CC*P03X*P22A4	F	N	3.6	*	+	6	+	6	*5054	*0	29.93	61	3	85.5	3U	2400	0.0		85.0	3U	3000	0.0			N				
												2	85.5	3U	2300	0.0												
												4	85.0	2U	2500	0.0												
29-07	CC*P03X*P22A4	F	N	3.6	*	+	6	+	6	**48*	*0	29.*4	50	3	87.0	3U	2000	*.0		F						N				
												2	87.0	3U	2400	*.0												
												4	86.0	3U	2600	*.0												
22-01	CC*P03X*P22A4	F	N	3.6	*	+	6	+	6	23*30	*0	29.2*	61	3	82.0	4U	2500	*.0		81.0	4U	2800	2.0	N	93.0	80.9	N				
												2	81.0	4U	2300	0.0		80.0	4U	2500	0.0								
												4	83.0	4U	2500	*.0		82.0	4U	2800	0.0								

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M T	C A T S	C.R.	I A P	SPARK ADVANCE: AS RCD	AS TST	ODOM MILES	WEATHER: AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: P E R	MAXIMUM: OCT NO	G E A R	RPM	AC	PART-THROTTLE: OCT NO	G E A R	RPM	AC	TANK FUEL INFORMATION: OCTANE NO	RATED: RES	MOTR	RPM	AC
01-01	CC*PC3*P1244	P	N	3.8	Y	+ 6	- 6	33200	70		50	1	92.0	4L	2300	0.6	92.0	4L	2300	2.0	N	91.0	92.0		N	
												2	90.0	4L	2000	0.6	92.0	4L	2000	2.0						
												4	90.0	4L	2300	0.6	90.0	4L	2300	0.0						
05-03	CC*PC3*P1244	P	N	3.8	Y	+ 6	- 6	7800	75	29.45	77	1	90.0	3L	2200	1.0	86.5	4L	2000	3.0						
												2	89.0	4L	2000	0.6										
												4	88.0	4L	2100	0.6										
03-01	CC*PC3*P1244	P	N	3.8	Y			15657	70	28.61	61	1	92.0	3L	2400	1.0	P						N			
												2	86.0	3L	2300	1.0										
												4														
47-15	CC*PC3*P1244	C	N	3.8	Y	+ 6	+ 6	5901	70	28.99	60	1	92.0	4L	2500	1.0	-									
												2	88.0	4L	2500	1.0										
												4	87.0	4L	1900	1.0										
47-21	CC*PC3*P1244	C	N	3.8	Y	+ 6	+ 6	7951	70	29.39	50	1	95.0	4L	2250	0.6	92.0	4L	2250	1.6						
												2	96.0	4L	2250	0.6										
												4	95.0	4L	2000	0.6										
09-09	CC*PJT*P12M5	P	-	7.8	Y	+ 9	+ 9	3690	79	30.22	101	1	92.5	3	4000	-9.6	90.0	3	4800	-5.6	N	93.0	87.0		N	
			-									2	92.0	4	3500	-9.6	90.0	3	4700	-6.0						
			-									4	93.0	3	4000	-9.6										
			-									1	93.5	3	4000	-9.6										
			-									2	93.0	4	3600	-9.6										
			-									4														
09-15	CC*PJT*P12M5	P	-	7.8	Y	+ 9	+ 9	7763	88	30.00	32	1	97.5	3	3800	-7.0	P				N	95.0	93.5		N	
			-									2	93.0	4	3500	-7.0										
			-									4	97.0	3	3800	-7.0										
			-									1	97.5	3	3800	-7.0										
			-									2	93.0	4	3500	-7.0										
			-									4	97.0	3	3800	-7.0										
46-04	CC*PJT*P12M5	P	M	7.8	Y	+ 9	+ 9	6384	70	29.50	78	1	97.0	3	3375	-6.0	P				N				N	
			M									2	93.0	3	3375	-6.0										
			M									4	89.0	3	2675	-6.0										
			-									1	97.0	3	3375	-6.0	P									
			-									2	93.0	3	3375	-6.0										
			-									4	89.0	3	3375	-6.0										

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: ENG TYP	SPARK ADVANCE: S/A	C.R.	AS RCD	AS TST	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	MAXIMUM: FUEL	OCT NO	GRADE	PPM	ACC	PARTIAL-BOTTLE: FUEL	OCT NO	GRADE	PPM	ACC	TANK FUEL INFORMATION: COMP	OCT NO RES	OCT NO MOTR	VAPR LOCK	GRADE	PPM	ACC
89-01	CC1FA2*P2344	F	9.6				10380	70	29.03	60	3	90.0	2	3400	0.6	L					N						
											2	92.0	2	2800	1.0	L											
											4																	
											3																	
											2																	
											4																	
89-02	CC1T12*P2340	F	N	9.0	+	+15	+15	10279	67	30.11	32	3	93.0	3	2300	0.6	92.0	3	0850	2.0	N	92.4	92.0	A	M	3	2350	0.6
											2	95.0	3	2850	0.6												
											4	90.0	3	2300	0.6												
89-10	CC1T12*P2340	F	N	9.0	+	+15	+15	10327	88	30.00	38	3	94.0	2	3000	0.6	F					N	96.4	97.0	B	M	3	0350	0.6
											2	95.0	3	2550	0.6												
											4	92.0	2	1950	0.6												
89-05	CC1T12*P2340	F	N	9.0	+	+15	+15	10549	70	29.39	60	3	89.5	3	2500	0.6	88.0	3	0800	1.6				N				
											2	91.0	3	2900	0.6												
											4	88.5	3	1000	0.6												
89-23	CC1T12*P2340	F	N	9.0	+	+15	+15	10515	72	29.97	50	3	90.0	3	2500	0.6	91.0	3	0400	1.6				B	M	3	2500	0.6
											2	90.0	3	2500	0.6												
											4	89.0	3	1500	0.6												
89-07	CC1T12*P2340	F	N	9.0	+	+15	+15	10384	79	30.02	110	3	88.0	3	2500	0.6	F							N				
											2	88.0	3	2500	0.6												
											4	86.0	3	2500	0.6												
89-04	CC1T12*P2340	F	N	9.0	+	+15	+15	10605	54	30.43	17	3	91.0	3	2700	0.6	87.0	3	0800	1.6				N				
											2	92.0	3	2600	0.6												
											4	90.0	3	0750	0.6												
89-09	CC1T12*P2343	C	N	9.0	Y	+15	+15	11400	70	29.93	50	3	90.0	3	2600	0.6	88.0	3	0750	1.0								
											2	91.0	3	2650	0.6												
											4	88.0	3	2250	0.6												
89-08	CC1T82*P23M5	F	N	9.0	+	+12	+15	20466	70	29.28	60	3	90.0	3	2000	0.6	90.0	4	1400	0.0		90.0	92.0					
											2	90.0	4	1400	0.6	90.0	4	1400	0.0								
											4	93.0	4	1400	0.6	93.0	4	1500	0.0								
89-06	CC1D02*P2344	F		9.3	+	+12	+12	8128	68	30.20	32	3	93.0	4L	1650	1.0	F					N	96.8	97.0	N				
											2	94.0	2U	2300	0.6												
											4	92.0	4L	1550	1.0												
											3	93.0	4L	1750	1.0												
											2	93.0	2L	2000	0.6												
											4	92.0	4L	1650	1.0												

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	MODEL CODE	VEHICLE DESCRIPTION: ENGINE TYP	ENGINE CYL	ENGINE DISP	SPARK ADVANCE: MAN TRANS	SPARK ADVANCE: AUTO TRANS	ODOM MILES	AMB TMP	BAROM	HUM	WEATHER: OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: SPEED	MAXIMUM: OCT NO	MAXIMUM: GEAR	MAXIMUM: RPM	MAXIMUM: VAC	PART-THROTTLE: SPEED	PART-THROTTLE: OCT NO	PART-THROTTLE: GEAR	PART-THROTTLE: RPM	PART-THROTTLE: VAC	TANK FUEL INFORMATION: OCTANE NUMBER: RES	OCTANE NUMBER: MOTR	VAPOR LOCK: MAN TRANS	VAPOR LOCK: AUTO TRANS	VAPOR LOCK: GEAR	VAPOR LOCK: RPM	VAPOR LOCK: VAC
03-16	001CL2*P01A4	F	8.0	N	+10	+10	9663	74	30.00	49	3	90.0	3U	2250	0.5	89.0	4L	1650	3.0	N	96.7	88.0	N				
											2	84.0	2U	2350	0.5												
											4	82.0	1U	3000	0.5												
											3	80.0	3L	2150	1.0												
											2	93.0	2U	2450	0.5												
											4	92.0	4L	1550	1.0												
04-10	001CL2*P01A4	F	8.0	N	+10	+10	10357	70	29.47	60	3	90.0	2U	2300	0.5	91.5	3L	1400	1.5		97.5	88.0	A	M	4L	1600	1.5
											2	84.0	2U	2000	0.5												
											4																	
											3	82.0	4L	1800	0.5												
											2	90.0	4L	1800	0.5												
											4																	
04-01	001CL2*P01A4	C	8.0	N	+10	+10	10456	70	30.10	66	3	89.0	3L	1600	0.5								B	M	4L	1600	1.0
											2	91.0	2U	2400	0.5	80.0	3L	1600	3.0								
											4	88.0	4L	1700	1.0												
											3	86.0	3L	1400	0.5												
											2	89.0	2U	2400	0.5	88.0	3L	1600	3.0								
											4	86.0	4L	1500	1.0												
05-10	001CL2*P01A4	F	8.0	N	+10	+10	14000	78	29.45	71	3	85.0	4L	1600	0.5	86.0	4L	1600	5.0								
											2					88.0	4L	1600	5.0								
											4	90.5	4L	1600	0.5	89.0	4L	1600	5.0								
											3	85.0	4L	1600	0.5	85.0	4L	1600	5.0								
											2																	
											4																	
06-07	001CL2*P01A4	F	8.0	N	+10	+10	24094	77	29.84	104	3	94.0	4L	1600	0.5	88.0	4L	1550	3.0				N				
											2	95.0	4L	1775	0.5												
											4	94.0	4L	1300	0.5												
											3	92.0	4L	1425	0.5												
											2	93.0	4L	1475	0.5												
											4	91.0	4L	1575	0.5												
08-01	001CL2*P01A4	F	8.0	N	+10	+10	16827	47	30.12	77	3	97.0	3L	2500	0.5	86.0	4L	1407	1.5				A	P	4L	1600	1.5
											2	97.0	4L	1400	0.5												
											4	96.0	4L	1400	0.5												
											3	95.0	4L	1500	0.5												
											2	96.0	4L	1500	0.5												
											4	94.0	4L	1350	0.5												

1984 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	ENGINE MAL TYP	SPARK ADVANCE LOCK PROG	SPARK ADVANCE LOCK TEST	ODOM MILES	AMB TMP	BAROM PRESS	NUM OF TEST	MAXIMUM OCT NO	MAXIMUM GEAR	MAXIMUM RPM	MAXIMUM VAC	PART-THROTTLE OCT NO	PART-THROTTLE GEAR	PART-THROTTLE RPM	PART-THROTTLE VAC	CONT KNOCK	TANK FUEL INFORMATION: RATED OCT NO	TANK FUEL INFORMATION: RATED KNOCK INT	TANK FUEL INFORMATION: RATED GEAR	TANK FUEL INFORMATION: RATED SPEED	TANK FUEL INFORMATION: RATED VAC
38-11	CC1C4xPCCM6	P N	8.8 N		6801	46	30.09	27	85.5	4	3000	0.4	83.0	4	1800	1.4	N	88.8	87.8	N		
								2	88.0	3	4500	0.4										
								4	86.5	4	3000	0.4										
								0	85.5	4	3000	0.4	83.0	4	1800	1.4						
								2	88.0	3	4500	0.4										
								4	86.5	4	3000	0.4										
47-14	CC1C4IxPC3A4	C N	8.0 N	+10	+10	6780	70	30.10	45	86.0	3L	2400	1.0	86.0	3L	2000	4.0	N	86.7	86.8	M	3L	2000	0.7
								2	86.0	3L	2400	1.0	86.0	3L	2450	4.0						
								4	86.0	3L	2900	1.0	86.0	3L	1800	0.6						
33-15	CC1C4IxPC3A4	P N	8.0 N	+10	+10	17184	70	29.07	50	87.0	4L	1800	1.2	86.0	4L	1850	0.0	N	87.9	88.2	N			
								2	87.0	4L	1400	1.2	87.0	4L	1850	0.0						
								4	87.0	4L	1400	1.0	86.0	4L	1800	0.0						
33-16	CC1C4IxPC3A4	P N	8.0 N	+10	+10	8744	70	29.19	50	88.0	4L	1600	1.0	88.0	3L	1810	0.0	N		N			
								2	88.0	4L	1600	1.0	89.0	3L	2000	0.0						
								4	88.0	4L	1650	1.0	88.0	3L	1850	0.0						
47-10	CC1C4IxPC3A4	C N	8.0 N	+10	+10	9850	70	29.85	50	91.0	3L	2400	0.8	88.0	4L	1800	2.0						
								2	90.0	3L	2800	0.8										
								4	89.0	3L	2900	0.8										
47-12	CC1C4IxPC3A4	C N	8.0 N	+10	+10	8800	70	30.10	50	90.0	3L	2250	1.0	88.0	4L	1800	2.0						
								2	90.0	3L	2250	1.0										
								4	88.0	3L	2000	1.0										
37-13	CC1C4IxPC3A4	P N	8.0 N	+10	+10	3674	72	29.35	50	86.0	3L	2300	0.0	F				N	83.0	83.4	N			
								2	87.0	3U	2900	0.0										
								4	90.0	3L	2900	0.0										
38-14	CC1C4IxPC3A4	P N	8.0 Y	+10	+10	5891	80	30.15	50	90.0	2	2850	0.4	85.0	4	1400	1.4	N	88.2	88.7	M	3	2000	0.4
								2	86.0	2	2850	0.4										
								4	90.0	4	1800	0.4										
38-15	CC1C4IxPC3A4	P N	8.0 Y	+10	+10	6065	69	30.00	32	95.0	2	2850	0.8	F				N	88.5	89.0	N			
								3	87.5	2	3050	0.8										
								4	93.0	2	2750	0.8										
38-17	CC1C4IxPC3A4	P N	8.0 Y	+10	+10	16540	69	30.00	23	91.0	3	1550	0.8	89.0	3	1850	0.0						
								2	93.0	2	3150	0.8										
								4	90.0	2	2750	0.8										
33-17	CC1C4IxPC3A4	P N	8.0 Y	+10	+10	16937	70	29.48	50	91.5	4	1200	0.4	90.0	4	1450	0.8		91.9	92.4	M	3	2000	0.4
								2	92.5	4	1200	0.4										
								4	90.0	4	1200	0.4										

1983 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	EM	CYL	L	SPARK ADVANCE AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	E	MAXIMUM OCT NO	G E A R	RPM	LAC	PART-THROTTLE OCT NO	G E A R	RPM	LAC	C M N	TANK FUEL INFORMATION OCT NO	RES	MOTR	FUEL N G T E	M A N U A L	G E A R	RPM	LAC
03-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	22602	70	28.62	60	3	84.0	4	1150	0.2	84.5	4	1100	2.0		92.0	92.7	A	M	2	1900	0.1
												1	85.5	2	3000	0.2												
												4	84.5	4	1175	0.2												
04-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	11826	70	30.02	67	3	91.0	2	2300	0.3					N	95.5	95.3	N				
												2	92.0	3	2800	0.3												
												4	90.0	3	2200	0.3												
05-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	9636	70	29.80	60	3	90.0	3	3000	0.5	90.0	3	1800	1.5								
												2	93.0	3	4100	0.5												
												4	90.0	3	2200	0.5												
06-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	13084	70	29.47	60	3	91.0	4	1150	0.7	91.0	4	1050	1.0	Y	92.0	92.0	B	M	4	1800	0.6
												2	91.0	4	1350	0.7	91.0	4	1250	1.0								
												4	91.0	4	1350	0.7	91.0	4	1250	1.0								
09-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	6750	67	29.60	70	3	84.5	4	1400	1.0	84.5	3	1150	3.5								
												2	85.0	4	1500	1.0												
												4	84.0	4	1450	1.0												
47-01	CC1S42*P03A4	F	N	3.0	Y	+10	+10	15361	70	29.88	60	3	91.0	2	3200	0.2	88.0	4	1400	1.2								
												2	92.0	2	3600	0.2												
												4	90.0	2	3000	0.2												
47-03	CC1S42*P03A4	C	N	3.0	Y	+10	+10	22690	70	29.87	61	3	93.0	2	2800	0.2	91.0	4	1900	1.0	N	97.0	93.0	N				
												2	94.0	2	3500	0.2												
												4	91.0	2	2600	0.2												
47-04	CC1S42*P03A4	F	N	3.0	Y			6089	71	30.10	64	3	92.0	3	2000	0.2	F								B	M	4	900	0.1
												2	93.0	2	1200	0.2												
												4	90.0	3	1900	0.2												
04-04	CC1S42*P03A4	B	N	3.0	Y			6107	42	29.50	42	3	97.0	3	2050	1.2	F											
												2	95.0	3	1800	1.2												
												4	96.0	3	2400	1.2												
47-04	CC1P82*P03A4	C	N	3.8	Y	+10	+10	20589	75	30.17	33	3	88.0	4	850	1.0								N				
												2	89.0	4	1200	1.0												
												4	87.0	4	1000	1.0												
05-04	CC1P82*P03A4	F	N	3.8	Y	+10	+10	11198	70	29.78	61	3	87.0	3	2250	0.8	87.0	4	1000	3.0		92.0	90.7					
												2	88.0	3	2450	0.8	88.0	4	900	3.0								
												4	87.0	3	2300	0.8	87.0	4	850	3.0								
06-04	CC1P82*P03A4	F	N	3.8	Y	+	3	+	3	16325	70	29.78	60	3	89.0	4	1100	1.0	41.0	4	850	3.0	N	97.0	90.6	N				
												2	89.0	4	1400	1.0	90.0	4	950	3.0								
												4	88.0	4	1200	1.0	88.0	4	850	3.0								

1989 CRC OCTANE NUMBER REQUIREMENT DATA BY

OBS NO	MODEL CODE	E M C T	S	C.R.	A I R	SPARK ADVANCE AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	F U E L	OCT NO	A B	RPM	VAC	OCT NO	A B	RPM	VAC	C M N O	OCT NO RES	OCT NO MOTR	N O T E	A B	RPM	VAC
1	C2*FP2*P50A4	F	N	3.0	*	+*0	+*0	0*4*2	80	29.90	66	3	91.0	4	950	0.4	9*.0	4	950	*.4				*			
												2	92.0	4	925	0.4											
												4	90.0	4	*050	0.4											
2	C2*FP2*P50A4	F	N	3.0	*	+	0	+	0	*55*0	*2	30.*4	06	3	86.0	0	2900	0.7	92.0	3	0*50	0.0			N			
												2	87.0	3	0000	0.7											
												4	86.0	3	0000	0.7											
3	C2*FP2*P50A4	F	N	3.0	*	+	0	+	0	*56*6	*0	29.42	60	3	84.0	3	2*00	0.4	92.0	0	2000	*.6		84.2	92.4	B	M	0	0800	0.*
												2	86.0	3	0800	0.4											
												4	83.6	3	0000	0.2											
4	C2*F*2*P50A4	F	N	3.0	*	+*5	+*5	*0500	80	29.40	*05	3	90.0	3	2800	0.6	99.0	3	0800	0.0							
												2	90.0	3	2800	0.6											
												4	88.0	3	0800	0.6											
5	C2*F*2*P50A4	F	-	3.0	*	+*0	+*0	*6*9	*0	29.*7	50	3	88.0	4	*700	*.0	98.0	4	*500	4.0	N			N			
			-									2	88.0	4	*700	*.0	99.0	4	*550	4.0							
			-									4	88.0	4	*650	*.0	98.0	4	*500	4.0							
			-									1															
			-									2															
			-									4															
6	C2*F*2*P50A4	F	-	3.0	*	+*0	+*0	*605*	*8	29.60	66	1	91.0	2	*700	*.0	F				N			B	M	0	450
			-									2	90.0	2	*650	*.0											
			-									4	88.0	2	*600	*.0											
			-									1	90.0	2	*500	*.0	F										
			-									2	91.0	3	*850	*.0											
			-									4	88.0	2	*800	*.0											
7	C2*F*2*P50A4	F	N	3.0	*	+*0	+*0	*3*0	68	29.90	00	3	91.0	2	2850	0.6	F										
												2	92.0	2	2800	0.8											
												4	90.0	3	0*50	0.6											
8	C2*F*2*P50A4	F	N	3.0	*	+*0	+*0	*4200	*0	29.60	60	3	92.6	2	2*00	0.2	92.0	4	*300	*.6		84.0	84.6	A	M	0	0*0.
												2	94.0	2	2800	0.0											
												4	90.6	4	*000	0.0											
9	C2*F*2*P50A4	F	N	3.0	*	+*0	+*0	*548	64	30.00	67	3	92.0	0	0050	0.0	90.0	4	*450	0.0	N						
												2	92.6	2	0*50	0.0											
												4	91.0	4	*650	0.0											
10	C2*F*2*P50A4	F	N	3.0	*	+*0	+*0	*50*	*2	29.0*	8*	3	88.*	2	2800	*.0	F				N	2*.8	88.4	N			
												2	89.0	2	2*50	*.0											
												4	88.0	2	2850	*.0											

1983 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO	MODEL CODE	VEHICLE DESCRIPTION (EM CN T / TS / CIR / A/R / BAS ROD / AR TST)	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	MAXIMUM OCT NO	GEAR	RPM	VAC	PART-THROTTLE OCT NO	GEAR	RPM	VAC	TANK FUEL INFORMATION (CWK / RES / MOTR / NT / R / GEAR / RPM / VAC)
[illegible]	00PPO*P8044	F N 5.0	10734	70	[illegible]	70	0	99.0	4	1300	0.4	87.0	4	1000	[illegible]	N 93.5 87.0 D M 4 [illegible]
							2	100.0	4	1300	0.4					
							4	98.0	4	[illegible]	0.4					
[illegible]	00PPO*P8044	F N 5.0 [illegible]	6044	70	29.33	50	0	92.5	2	2400	[illegible]					N 98.4 [illegible]
							0	[illegible]	0	2475	[illegible]					
							4	90.0	2	2000	[illegible]					
[illegible]	00PPO*P8044	F N 5.0 [illegible]	[illegible]	70	29.84	50	0	88.0	3	2600	0.6	[illegible]	4	[illegible]	[illegible]	[illegible]
							0	88.0	0	2550	[illegible]	88.0	4	[illegible]	[illegible]	
							4	88.0	[illegible]	2050	0.5	88.0	4	[illegible]	[illegible]	
[illegible]	00PPO*P8044	F N 5.0 [illegible]	[illegible]	70	29.84	50	0	92.0	4	1150	0.4	94.0	4	[illegible]	[illegible]	N 93.0 83.0 3 P 4 [illegible]
							2	92.0	4	1150	0.4	94.0	4	[illegible]	[illegible]	
							4	90.0	0	1500	[illegible]	90.0	4	800	[illegible]	
[illegible]	00PPO*P8044	F N 5.0	[illegible]	[illegible]	29.86	100	0	88.0	0	2500	[illegible]	F				N 93.5 [illegible]
							0	87.0	0	2500	[illegible]					
							4	87.0	4	1900	[illegible]					
[illegible]	[illegible]	F N [illegible]	[illegible]	70	29.73	51	0	90.0	4	2450	[illegible]	92.0	4	1400	[illegible]	N 93.0 84.0 N
							0	[illegible]	4	1500	[illegible]	90.0	4	1600	3.0	
							4	90.0	4	2500	[illegible]	90.0	4	2000	[illegible]	
[illegible]	00PPO*P8044	[illegible]	[illegible]	70	29.88	50	0	91.5	4	1400	0.5	90.5	4	1400	0.5	
							0	91.5	4	1400	0.5					
							4	91.5	4	1400	0.5					
[illegible]	[illegible]	F N [illegible]	8050	55	29.66	70	0					88.0	3L	1500	[illegible]	
							0					85.5	3L	1500	[illegible]	
							4					87.0	3L	1500	0.0	
[illegible]	[illegible]	E N [illegible]	11307	75	29.43	95	3	86.0	3L	2300	[illegible]	83.0	3L	1650	4.0	N [illegible] N
							0	88.0	3L	2050	[illegible]					
							4	90.5	3L		[illegible]					
[illegible]	[illegible]	F [illegible] 5.0 Y	9307	75	29.34	70	0	88.0	3L	2350	[illegible]	86.0	3L	2250	4.0	N
							2	89.0	3L	2300	[illegible]					
							4	84.0	3L	2050	[illegible]					
							0	86.0	3L	2000	[illegible]					
							0	87.0	3L	2350	[illegible]					
							4	90.0	3L	2000	2.0					

1989 CFC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION										WEATHER		OCTANE NUMBER REQUIREMENT DATA											TANK FUEL INFORMATION								
													MAXIMUM					PART-THROTTLE														
					SPARK ADVANCE																												
VEH. NO.	MODEL CODE	ENGINE CODE	TRANS	DRIVE	A/C	AIR PUMP	CAT CONV	EGR TEST	ODOM MILES	AMB TMP	BAROM	H2O	ENGINE SPEED	OCT NO	A/C	FUEL	RPM	A/C	OCT NO	A/C	FUEL	RPM	A/C	OCTANE NO.	PRES	MOTR	WINTER GRADE	FUEL	RPM	A/C	SUMMER GRADE	FUEL	RPM	A/C
1																																
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1989 GPC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO	MODEL CODE	VEHICLE DESCRIPTION: EM	SPARK ADVANCE: A	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	FUEL	MAXIMUM: OCT NO	MAXIMUM: SENS	MAXIMUM: APP	MAXIMUM: ADJ	PART-THROTTLE: OCT NO	PART-THROTTLE: SENS	PART-THROTTLE: APP	PART-THROTTLE: ADJ	TANK FUEL INFORMATION: COMMENTS	TANK FUEL INFORMATION: OCT NO	TANK FUEL INFORMATION: SENS	TANK FUEL INFORMATION: APP	TANK FUEL INFORMATION: ADJ
00109	CC*4W2*PD844	F	8.0	8548	89	29.71	23	3	91.0	3L	0000	1.0	89.0	3L	1700	3.0					
								2	91.0	3L	0000	1.0									
								4	88.0	4L	1700	1.0									
								3	89.0	3L	0000	1.0									
								2													
								4													
00110	CC*4W2*PD844	F	8.0	10359	84	29.07	82	3	93.0	3L	0000	1.0	92.0	3L	0100	3.0					
								2	95.0	3L	0000	1.0									
								4	92.0	3L	0000	1.0									
								3	92.0	3L	0000	1.0									
								2													
								4													
00117	CC*BB2*T5144	F	8.0	5484	70	29.58	50	3	93.0	3L	1400	2.7	86.0	3L	1800	4.0					
								2	93.0	2L	1400	2.7									
								4	91.0	3L	1400	2.7									
								3	91.0	2L	1400	2.7	84.0	3L	1800	4.0					
								2	91.0	3L	1400	2.7									
								4	91.0	3L	1400	2.7									
00118	CC*BB2*T5144	F	8.0	6103	84	29.68	68	3	86.0	3L	2000	1.4	88.0	4L	1100	1.6					
								2	87.0	4L	1100	1.6									
								4	89.0	3L	2000	1.4									
								3	88.0	3L	2000	1.4									
								2													
								4													
00119	CC*BB2*T5144	F	8.0	4227	70	29.84	38	3	88.0	4L	1100	1.8	87.0	4L	1200	3.0					
								2	91.0	4L	1200	1.8									
								4	87.0	3L	1700	1.8									
								3	86.0	4L	1100	1.8									
								2													
								4													
00120	CC*BB2*T5144	F	8.0	6669	87	29.80	76	3	90.0	4L	1100	2.0	89.0	4L	1100	3.0					
								2	91.0	3L	1400	2.0									
								4	89.0	4L	1100	2.0									
								3	90.0	4L	1100	2.0									
								2													
								4													

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	EM T	EM S	EM C.R.	SPARK ADVANCE A P	AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	OCT NO	MAXIMUM SENS	MAXIMUM A P	MAXIMUM PPM	MAXIMUM ΔAC	PART-THROTTLE OCT NO	PART-THROTTLE SENS	PART-THROTTLE A P	PART-THROTTLE PPM	PART-THROTTLE ΔAC	TANK FUEL INFORMATION OCTANE NO. K	OCT NO RES	OCT NO MOTR	RATED OCTANE NO. T	RATED OCTANE NO. A P	RATED OCTANE NO. PPM	RATED OCTANE NO. ΔAC
19-01	CDYL12*T2140	F	N	3.0	+			8777	81	30.03	75	1	92.5	SL	2600	0.3						N	93.4	92.4	N			
												2	95.5	SL	2600	0.3												
												4	95.0	SL	2650	0.3												
19-15	CDYL12*T2140	F	N	3.0	+			14782	72	30.40	54	1	93.5	2L	2300	1.5	93.5	SL	2800	0.0	+	94.4	94.0	N			
												2	96.0	SL	2300	1.5	96.0	SL	2300	0.0								
												4	90.5	2L	2900	1.5												
19-19	CDYL12*T2140	F	N	3.0	+			10240	72	29.62	60	1	95.0	2U	2650	0.3	F							N			
												2	96.5	2L	2400	0.5												
												4																
19-19	CDYL12*T2140	F	N	3.0	+			7301	74	29.92	75	1					95.0	SL	2450	0.0								
												2					97.0	SL	2200	4.5								
												4					97.0	SL	2450	0.0								
19-19	CDYL12*T2140	F	N	3.0	+			19577	66	29.65	40	1	88.0	2L	2600	0.0	97.0	SL	2600	1.5								
												2	88.0	SL	2700	0.0												
												4	97.0	2L	2600	0.0												
19-1	CDYLW1*P2140	F	-	3.0	+			8201	88	29.77	86	1	93.0	SL	2300	1.0	98.0	SL	1925	2.0					A M	SL	2025	0.0
			-									2	93.0	SL	2275	1.0												
			-									4	90.0	SL	2301	1.0												
												1	96.0	SL	2775	1.0												
			-									2	97.0	SL	2625	1.0												
			-									4	90.0	SL	2775	1.0												
19-1	CDYL12*T2140	F	N	3.0	+			8362	84	29.28	67	1	96.0	SL	1951	0.0	95.0	SL	1750	7.0					N			
												2	97.0	3L	2000	0.0	99.0	SL	1951	7.0								
												4	94.0	SL	2000	1.0												
19-17	CDYL12*T2140	F	N	3.0	+			12053	70	29.62	57	1	99.0	SL	1951	0.0	99.0	SL	1750	5.5					N			
												2	97.0	SL	1950	2.0	97.0	SL	1800	5.5								
												4	97.0	SL	1950	0.0												
19-19	CDYL12*T2140	F	N	3.0	+			10329	70	29.05	61	1	99.0	SL	1951	0.0	99.0	SL	1700	0.0					N			
												2	99.5	SL	1900	0.5												
												4	97.0	SL	1100	0.0												
19-1	CDYL12*T2140	F	N	3.0	+			14802	70	29.67	59	1	90.0	SL	2000	0.7	97.0	SL	2600	0.0					N			
												2	91.0	SL	2200	0.7												
												4	88.0	2L	2600	0.7												
19-19	CDYL12*T2140	F	N	3.0	+			2760	72	29.05	82	1	97.0	SL	1950	1.5	95.0	SL	1950	0.5								
												2	99.0	SL	1950	1.5												
												4	95.0	SL	1950	1.5												

1983 CFR OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	E M C T	S	A I R	SPARK ADVANCE *S POD	AS TST	ODOM MILES	AMB TMP	BAROM	H-M	F E L	OCT NO	G E A R	RPM	LAC	OCT NO	G E A R	RPM	LAC	D W E N	OCT NO	N I T R	G E A R	RPM	AC
47-10	CO1L1GAT2B4B	C	N	3.0	Y		19000	70	29.35	50	3					88.0	3L	1650	5.0						
											2					121.0	3L	1700	5.0						
											4					92.0	3L	1600	5.0						
48-07	CO1LA1XP2B4B	P	-	3.8	Y		12570	70	29.39	46	3	92.0	3U	2800	1.6	88.0	3L	2250	4.6			B	M	3U	2800
			-								2	94.0	3L	2600	1.6	90.0	3L	2300	4.6						
			-								4	89.0	3U	3250	1.0	86.0	3L	2850	4.6						
			-								3	89.0	3L	2300	1.0										
			-								2	91.0	3U	2650	1.6										
			-								4	86.0	3L	2400	1.6										
49-06	CO1LA1XP2B4B	P	-	3.8	Y		8075	70	29.62	50	3	89.0	3L	2800	1.4	P				N	90.4	91.7	B	M	2U	2450	1.4
			-								2	91.0	2L	2350	1.4										
			-								4	86.0	3L	2400	1.0										
			-								3	87.0	2L	2500	1.4										
			-								2	90.0	3L	2400	1.4										
			-								4	85.0	3U	2350	1.4										
50-01	CO1LW1XP2B4B	P	-	3.8			9787	67	29.66	50	3	91.0	3L	3000	1.4	90.0	3L	2000	2.8						
			-								2	93.0	3L	3000	1.4										
			-								4	90.0	3L	3100	1.4										
			-								3	91.0	3L	3000	1.4										
			L								2														
			-								4														
16-12	CO1LA1XP2B4B	P	-	3.8			11412	69	29.78	53	3	88.0	3L	2500	1.0	86.0	3L	2050	1.0				N		
			-								2	93.0	3L	2600	0.6										
			M								4	91.0	2L	2150	0.4										
			-								3	85.0	3L	2750	0.6										
			-								2	86.0	3L	2600	0.6										
			-								4	91.0	3L	2050	0.4										
24-13	CO1LA1XP2B4B	P	-	3.8	Y		6984	67	29.60	38	3	87.0	3L	1600	0.9	87.0	3L	1300	1.0						
			-								2	87.0	3L	1750	0.9	87.0	3L	1300	1.0						
			-								4	87.0	3L	1750	0.9	87.0	3L	1900	1.0						
			-								3	84.0	3L	1750	0.9	84.0	3L	1640	1.0						
			-								2	85.0	3L	1810	0.9	85.0	2L	1640	2.0						
			-								4	84.0	2L	1800	0.9	84.0	3L	1650	1.0						

1999 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: ENGINE TYPE	CYL	DISP.	SPARK ADVANCE: LOCK	AS REC	AS TST	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: PART-THROTTLE	GEAR	OCT NO	A/F	RPM	VAC	PART-THROTTLE: GEAR	OCT NO	A/F	RPM	VAC	TANK FUEL INFORMATION: WINTER	OCT NO	MOTR	GRADE	RVP	RDM	AC
98-16	CO1WJX*P0343	F	6	3.9				8405	70	29.80	35	3		86.0	SD	0000	1.0	F					N	91.3	82.9	R	M	SD	0000	1.0
												2		87.0	SD	0350	1.0												
												4		88.0	SD	0325	1.0												
												3		84.0	SD	2750	1.0	F											
												2		86.0	SD	0125	1.0												
												4		88.0	SD	0375	1.0												
98-17	CO1*8JX*P0744	F	8	5.9	*	*	4	8	28871	87	30.00	76	3		91.0	4L	1800	1.0		90.0	4L	1800	1.0							
												2			91.0	SD	0500	0.8												
												4			89.0	4L	1200	1.0												
												3			90.0	4L	1800	1.0												
												2																		
												4																		
98-18	CO1*P0*T0540	F	N	5.0	*			7405	80	30.05	82	3		90.0	SD	0400	0.8	F					N							
												2			91.0	SD	0600	0.8												
												4			88.0	SD	0500	1.0												
98-19	CO1*P0*T0540	F	N	5.0	*			8066	68	30.00	67	3		90.0	SD	0600	0.8						N							
												2			91.0	SD	0600	0.8												
												4			88.0	SD	0300	0.8												
98-20	CO1WJX*P0340	F	6	3.9	*			76994	70	30.10	60	3		88.0	SD	0850	1.4	F					N	94.7	85.2	R	M	SD	0800	1.4
												2		100.0	SD	2700	1.4												
												4		86.0	SD	2700	1.4												
												3		87.0	SD	2800	1.4												
												2		88.0	SD	2750	1.4												
												4		86.0	SD	2700	1.4												
98-21	CO1WJX*P0340	F	6	3.9	*			7000	66	29.60	64	3		89.0	SD	0350	1.0	F												
												2		89.0	SD	0000	1.0												
												4		87.0	SD	0150	1.0												
												3		87.0	SD	0050	1.0												
												2																		
												4																		
98-22	CO1WJX*P0340	F	6	3.9				5108	71	29.45	93	3											N		N					
												2																		
												4																		
												3																		
												2																		
												4																		

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	VEHICLE DESCRIPTION: MODEL CODE	E M C A T	S P A R K A D V A N C E			WEATHER: BAROM	MAXIMUM: OCT NO	MAXIMUM: E A P	MAXIMUM: PPM	MAXIMUM: VAC	PART-THROTTLE: OCT NO	PART-THROTTLE: E A P	PART-THROTTLE: PPM	PART-THROTTLE: VAC	TANK FUEL INFORMATION: C M N PRES	TANK FUEL INFORMATION: A V N OCT NO	RATED: E A P	RATED: PPM	RATED: EC
03-07	CCCH-CC*P0844	P				30.50	96.0	DU	2800	0.9	90.0	DU	1900	0.8		91.0	RU	I	M
							95.0	DU	2600	0.9									
							90.0	DU	2100	1.0									
							94.0	DU	2600	0.9									
							97.0	DU	2600	0.9									
							99.0	DU	2300	0.9									
03-13	CCCH-CC*P0844	P				30.27													
							96.0	4U	1850	0.8									
03-21	CCCH-CC*P0844	P				29.77	96.0	DU	1500	0.4	P				N	96.0	94.0	N	
							97.0	DU	2000	0.4									
							94.0	DU	1500	0.4									
03-17	CCCH-CC*P0844	P				29.67	96.0	DU	2800	1.0	90.0	4U	1450	0.8			N		
							97.0	DU	2800	1.0									
							94.0	DU	2400	1.0									
							96.0	DU	2800	1.0	94.0	DU	2400	1.0					
							96.0	DU	2300	1.0									
							94.0	DU	2400	1.0									
03-19	CCCH-CC*P0844	P				29.67	92.0	DU	1950	1.0	90.0	DU	2000	0.8			N		
							95.0	DU	2000	1.0									
							86.0	DU	1900	1.0									
							90.0	DU	2000	1.0									
							90.0	DU	1950	1.0									
							85.0	DU	1900	1.0									
03-27	CCCH-CC*P0844	P				29.32											N		

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION											WEATHER				OCTANE NUMBER REQUIREMENT DATA													TANK FUEL INFORMATION								
															MAXIMUM						PART-THROTTLE															
				SPARK ADVANCE																																	
TEST NO	MODEL CODE	CYL	VAC	O.R.	EM P	AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	ENG	OCT NO	AIR P	FUEL PPM	FAC	OCT NO	AIR P	FUEL PPM	FAC	CW VAC	OCT NO	MOTR	EM P	AIR P	FUEL PPM	FAC										
47-19	CCC4-CCxP0844	C	-	8.5	+			20700	70	30.04	60	C	91.0	4L	1400	0.6	89.0	4L	1600	0.0																
			-									2	92.0	4L	1400	0.6																				
			-									4	89.0	4L	1400	0.6																				
			-									1	89.0	4L	1600	0.6																				
			-									2																								
			-									4																								
48-19	CCC4-CCxP0844	E	-	8.5	+			17261	78	29.29	80	C	-				-				N															
			-									2	-																							
			-									4	-																							
			-									1	-				-																			
			-									2	-																							
			-									4	-																							
49-19	CCCLxCxTCD40	C	N	8.8	+	-	B	+	B	18487	70	29.97	65	C	88.0	GL	2750	1.0	89.0	GL	2500	0.6		92.0	88.0	B	M	GL	2400	1.0						
													2	89.0	GL	2450	0.8	90.0	GL	2400	0.0														
													4	88.0	GL	2600	1.0	88.0	GL	2400	0.6														
50-19	CCCN04xP01A0	F	-	8.5	+			10661	71	29.49	60	C	88.0	GL	1750	0.7	84.0	GL	1800	0.0				N											
			-									2	84.0	GL	1700	0.7																			
			-									4	80.0	GL	2100	0.7																			
			-									1	91.0	GL	1800	0.7																			
			-									2	88.0	GL	1900	0.7																			
			-									4	89.0	GL	2000	0.7																			
51-19	CCCN04xP01A0	F	-	8.5	+			10350	70	29.49	60	C	88.0	GL	1800	0.0	89.0	GL	1400	0.0				N											
			-									2	91.0	GL	1700	0.4																			
			-									4	87.0	GL	1800	0.0																			
			-									1	88.0	GL	1700	0.4																			
			-									2	90.0	GL	1900	0.4																			
			-									4	87.0	GL	2000	0.2																			
52-19	CCCN04xP01A0	F	+	8.5	+			20475	70	29.89	50	C	85.0	GL	2000	0.0	84.0	GL	2000	0.0		87.0	80.0	A	M	GL	2000	0.0						
			-									2	87.0	GL	1900	0.0	88.0	GL	2000	0.0														
			-									4	83.0	GL	1900	0.0																		
			-									3																							
			-									2																							
			-									4																							

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	A S P.	SPARK ADVANCE: A R	AS RCD	AS TST	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: E L	OCT NO	G E A R	RPM	JAC	PART-THROTTLE: OCT NO	G E A R	RPM	JAC	TANK FUEL INFORMATION: C M N	OCT NO	N N - W	G E A	RPM	JAC
88-19	CCINC04*P0CA0	F M - -	3.8	Y			10105	76	29.02	65	0	87.0	3L	2000	0.0	86.0	3L	2000	7.0					
		-									2	88.0	3L	2000	0.0	88.0	3L	2000	7.0					
		-									4	87.0	3L	2000	0.0									
		-									0	87.0	3L	2000	0.0									
		-									2													
		-									4													
88-18	CCINC04*P0CA0	F M - -	3.8	Y			19868	71	30.03	77	0	88.0	3L	1900	0.0	88.0	3L	2000	7.0			N		
		-									2	86.0	3L	1900	0.0									
		-									4	84.0	3L	2000	0.0									
		-									0	90.0	3L	2000	0.0									
		-									2	88.0	3L	2000	0.0									
		-									4	87.0	3L	2000	0.0									
88-17	CCINJ0*T0A0	F N - -	3.0	Y			9886	69	29.88	69	0	85.0	3L	2600	0.4	80.0	3L	2000	0.0	N	87.7	82.4	N		
											2	87.5	2L	3400	0.4									
											4	80.0	2L	2600	0.4									
88-16	CCINJ0*T0A0	F N - -	3.0	Y			19061	69	29.88	71	0	88.0	3L	2900	0.0									
											2	88.0	3L	2000	0.0									
											4	86.0	3L	2900	0.0									
88-15	CCINJ0*T0A0	F N - -	3.0	Y			1285	82	29.82	104	0	95.0	3L	1750	0.0	F							B W	3L	2000	0.0
											2	95.0	3L	1750	0.0									
											4	95.0	3L	1750	0.0									
88-20	CCIWW0*P0A44	F M - -	3.8	Y	4*B	4*B	21136	80	30.26	40	0	84.0	2L	2600	0.4	80.0	3L	2400	2.0	N			N		
		-									2	86.0	2L	2600	0.4									
		-									4	82.0	2L	2600	0.4									
		-									0	82.0	3L	2600	0.4									
		-									2													
		-									4													
88-14	CCIWW0*P0A44	F M - -	3.8	Y			12236	68	30.10	28	0	87.0	4L	1550	1.0	F				N	88.7	88.0	N		
		-									2	88.0	3L	2100	1.0									
		-									4	87.0	3L	2000	1.0									
		-									0	87.0	4L	1550	1.0									
		-									2	88.0	3L	2150	1.0									
		-									4	86.0	3L	2100	1.0									

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION								WEATHER			OCTANE NUMBER REQUIREMENT DATA									TANK FUEL INFORMATION							
					SPARK ADVANCE							MAXIMUM				PART-THROTTLE											
TEST NO.	MODEL CODE	ENGINE TYPE	CYL	DISP.	AIR PUMP	AIR TEST	ODOM MILES	AMB TMP	BAROM PRESS	HUM	FUEL LOT	OCT NO	E	SENS	AC	OCT NO	E	SENS	AC	COMMENTS	OCT NO RES	OCT NO MOTR	GRADE	E	SENS	AC	COMMENTS
1-04	CCCxxCxPC3A4	P	4	8.9			13'01	72	28.09	60	0	94.0	GL	2850	1.0	F					90.0	90.6	A	M	GL	2000	0.6
											2	94.0	GL	2800	1.0											
											4	90.0	GL	2700	1.0											
											0	90.0	GL	3450	0.6											
											2	94.0	GL	2800	1.0											
											4	89.0	GL	2800	1.0											
1-05	CCCxxCxPC3A4	P	4	8.9	+		20810	75	28.04	70	0	91.0	GL	1650	1.0	91.0	GL	1900	0.0		90.0	90.0	B	M	GL	2000	0.0
											2	92.0	GL	1500	1.0	88.0	GL	1700	0.0							
											4	92.0	GL	1750	1.0											
											0	88.0	GL	1500	1.0	83.0	GL	1750	0.0							
											2	90.0	GL	2000	1.0	80.0	GL	1900	0.0							
											4	88.0	GL	1700	1.0											
05-04	CCCxxCxPC3A4	P	4	8.9	+		10'01	80	28.75	68	0	88.0	GL	2800	1.0	+8.0	GL	1800	0.0	N	90.0	89.6	A				
											2	94.0	GL	2800	1.0											
											4	91.0	GL	1800	1.0											
											0	90.0	GL	3800	0.6											
											4																
06-07	CCCxxCxPC3A4	P	4	8.9	+		16088	66	28.87	78	0	90.0	GL	1800	1.0	80.0	GL	1800	1.0								
											2	92.0	GL	1700	1.0											
											4	87.0	GL	1650	0.0	87.0	GL	1650	1.0							
											0	88.0	GL	3300	1.0											
											2	90.0	GL	2800	1.0											
											4	87.0	GL	1800	0.0											
07-08	CCCxxCxPC3A4	P	4	8.9	+		3697	72	30.87	58	0	87.0	GL	3000	1.0	F				N	86.4	85.0	A				
											2	87.0	GL	2400	1.0											
											4	86.0	GL	2300	0.0											
											2																
											4																
08-07	CCCxxCxPC3A4	P	4	8.9	+		3807	66	28.66	49	0	92.0	GL	2100	4.0	F											
											2	90.0	GL	2100	4.0											
											4	90.0	GL	2100	4.0											
											0	90.0	GL	1950	0.6	F										
											2	90.0	GL	2100	4.0											
											4	88.0	GL	2100	4.0											

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	E M C T	S	C.R.	SPARK ADVANCE A I R	AS PCC	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	F U E L	MAXIMUM OCT NO	G E A R	RPM	LAC	PART-THROTTLE OCT NO	G E A R	RPM	LAC	TANK FUEL INFORMATION O M N OCT NO N PES	MOTR	R N I T	G E A R	RPM	LAC
19-08	CCCWTCXPGY44	P	S	8.5	Y			10005	74	29.84	73	3	89.0	3L	2750	2.0	89.0	4L	2550	4.5			N			
												2	90.0	3L	2700	2.0	90.0	4L	2300	4.5						
												4	86.0	4L	1650	1.5										
												3	86.0	4L	1900	1.5	84.0	4L	2550	4.5						
												2	86.0	4L	1725	1.5	85.0	4L	2300	4.5						
												4															
19-12	CCCWTCXPGY44	P	S	8.5	Y			10708	66	30.01	40	3	85.0	4L	1700	1.0	F						N			
												2	86.0	4L	1700	1.0										
												4	84.0	4L	1700	1.0										
												3	83.0	4L	1700	1.0										
												2	85.0	4L	1700	1.0										
												4	84.0	4L	1700	1.0										
19-16	CCCWTCXPGY44	P	S	8.5	Y			10076	74	29.74	34	3	86.0	3L	3000	1.5	84.0	4L	2000	5.0			N			
												2	86.0	3L	3000	1.5										
												4	82.0	4L	1600	1.0										
												3	85.0	3L	3000	1.5										
												2	86.0	3L	3000	1.5										
												4	87.0	4L	1800	1.0										
19-07	CCCWTCXPGY44	P	S	8.5	Y			9669	72	29.84	50	3	91.0	3L	2950	1.5							B	M	4L	1600	1.0
												2	94.0	3L	2700	1.5										
												4	89.0	4L	1700	1.5										
												3	89.0	3L	2950	1.5										
												2	90.0	3L	2700	1.5										
												4	89.0	4L	1700	1.5										
19-15	CCCWTCXPGY44	P	S	8.5	Y			8567	20	29.65	14	3	90.0	3L	3000	1.0	87.0	3L	2000	3.0						
												2	95.0	3L	3000	1.0										
												4	91.0	3L	3000	1.0										
												3	88.0	3L	3000	1.0										
												2															
												4															
19-10	CCCWTCXPGY44	P	S	8.5	Y			8970	62	30.02	21	3	93.0	4L	1550	1.0	89.0	4L	1600	3.0	N		A	M	3L	2000	1.0
												2	101.0	4L	1700	1.0										
												4	93.0	4L	1550	1.0										
												3	97.0	4L	1900	1.0										
												2	97.0	4L	1600	1.0										
												4	93.0	4L	1550	1.0										

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEH ID	VEHICLE DESCRIPTION: MODEL CODE	E M C T	S P A R K A D V A N C E S C.P.	A I R	A S R C D	A S T S T	WEATHER: ODOM MILES	AMB TMP	BAROM	H U M	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: F L	G E A R	OCT NO	R	RPM	VAC	PART-THROTTLE: G E A R	OCT NO	R	RPM	VAC	TANK FUEL INFORMATION: OCT NO	SENS	WGTD	FILTER: C O N T A M	G E A R	RPM	SD
1-01	CCCAPDA*C1540	P	N	5.0	Y		5427	82	28.84	44	3	86.0	2L	2400	7.5	P								N				
											2	87.0	2L	2400	7.5													
											4	84.0	2L	2400	7.5													
1-02	CCCAPDA*C1540	P	N	5.0	Y		10701	78	28.70	40	3	89.0	2L	2400	7.5		90.0	2L	1450	4.0				N				
											2	91.0	2L	2400	7.5													
											4	87.0	2L	2400	7.5													
1-03	CCCAPDA*C1540	P	N	5.0	Y		15487	70	28.49	60	3	88.0	2L	2400	8.0		88.0	2L	1400	4.0				B M	2L	1400	0.0	
											2	90.0	2L	2400	8.0													
											4	85.0	2L	2400	8.0													
1-04	CCCAPDA*C1540	P	N	5.0	Y		3668	85	30.22	36	3	86.0	2L	2400	8.5	P					Y			A M	2L	2400	0.0	
											2	87.0	2L	2400	8.5													
											4	84.0	2L	2400	8.5													
1-05	CCCAMDA*C1540	P	-	5.0	Y		16168	78	28.74	44	3	84.0	2L	1900	7.5	P								N				
			-								2	87.0	2L	2400	8.0													
			-								4	82.0	2L	1975	7.5													
			-								3	-																	
			-								2	87.0	2L	2400	7.5													
			-								4	[illegible]	2L	2400	7.5													
1-06	CCCAMDA*C1540	C	-	5.0	Y		17596	70	28.84	66	3	82.0	2L	2400	8.5		88.0	2L	2400	8.5		84.0	84.0	B M	2L	2400	0.0	
			-								2	87.0	2L	2400	8.5													
			-								4	88.0	2L	2400	8.5		86.0	2L	2400	8.5									
			-								3	88.0	2L	2400	8.5		88.0	2L	2400	8.5									
			-								2	89.0	2L	2400	8.5													
			-								4	87.0	2L	2400	8.5		86.0	2L	2400	8.5									
1-07	CCCAMDA*C1544	P	-	5.0	Y		20356	70	28.40	60	3	85.0	4L	1700	7.0		88.0	4L	1700	8.5		84.0	84.0	A M	4L	1700	0.0	
			-								2	86.0	2L	2400	8.5													
			-								4	83.0	4L	1800	7.0													
			-								3	82.0	4L	1900	7.0													
			-								2	85.0	4L	1900	7.0													
			-								4	80.0	4L	1900	7.0													
1-08	CCCAMDA*C1544	P	-	5.0	Y		1097	88	28.84	19	3	94.0	2L	2200	8.0		90.0	2L	2000	8.0									
			-								2	97.0	2L	2000	8.0													
			-								4	91.0	4L	2000	7.0													
			-								3	90.0	2L	2000	8.0													
			-								2																		
			-								4																		

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	N S	A I R	SPARE ACCELERATOR AS POD	AS TST	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM F L	OCT NO	G E A R	PPM	ACC	PART-THROTTLE OCT NO	G E A R	PPM	ACC	TANK FUEL INFORMATION: C M N N	OCT NO	N I T R	G E A R	PPM	ACC
89-04	CCCAN2#P0344	F -	3.0				95026	70	29.00	50	3	88.0	3L	1600	0.7	88.0	3L	1600	6.0			N			
		-									2	91.0	3L	1600	0.7	91.0	3L	1600	6.0						
		-									4	88.0	3L	1600	0.7										
		-									3	88.0	3L	1600	0.7	87.0	3L	1600	6.0						
		-									2	88.0	3L	1600	0.7	88.0	3L	1600	6.0						
		-									4	87.0	3L	1600	0.7										
89-11	CCCAN2#P0344	F -	3.0				80801	70	29.05	50	3	86.0	4L	1800	1.0	86.0	4L	1800	4.5			N			
		-									2	86.0	4L	1800	1.0	85.0	4L	1800	4.5						
		-									4															
		-									3	82.0	4L	1800	1.0										
		-									2	84.0	4L	1800	1.0										
		-									4															
89-13	CCCAN2#P0344	F -	3.0				81501	70	29.50	70	3					87.0	4L	1700	6.0						
		-									2					87.0	4L	1700	6.0						
		-									4	82.0	4L	1700	0.0	82.0	4L	1700	6.0						
		-									3					87.0	4L	1700	6.0						
		-									2															
		-									1															
		-									4															
89-17	CCCAN2#P0344	F -	3.0				72971	61	29.61	00	3	85.0	4L	1550	1.0	84.0	4L	1550	6.0	N	80.0	80.0	N	M	4L	1500	1.0
		-									2	87.0	4L	1550	1.0										
		-									4	83.0	4L	1550	1.0										
		-									3	84.0	4L	1550	1.0										
		-									2															
		-									1															
		-									4															
89-19	CCCCC2#P0344	F -	3.5				12786	70	29.67	50	3	-				-							N			
		-									2	-				-										
		-									4															
		-									3	-				-										
		-									2	-				-										
		-									4															
89-14	CCCEC2#P0344	E -	3.5				8103	70	29.65	70	3	-				-							N			
		-									2	-														
		-									4	-														
		-									3	-				-										
		-									2	-														
		-									4	-														

1988 CPG OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION											WEATHER			OCTANE NUMBER REQUIREMENT DATA													TANK FUEL INFORMATION								
														MAXIMUM						DIPSTICK/BOTTLE							RATED								
OBS NO.	MODEL CODE	C Y L	S C.P.	E M P	SPARK ADVANCE AS REQ	AS TST	ODOM MILES	AMB TMP	BAROM IN	F U E L	OCT NO	A P P	RPM	AC	OCT NO	A P P	RPM	AC	C Y L	E M P	OCT NO	MOTR	T P	E	RPM	AC									
1	CCC-CC*P2E44	C	8.5	-			2564	71	30.10	55	0	87.0	0	1900	0.5												N								
		-									2	88.0	0	2250	1.5																				
		-									4	88.0	0	2400	1.5																				
		-									0	90.0	0	1900	1.5																				
		-									2	94.0	0	2400	1.5																				
		-									4	97.0	0	2650	1.5																				
2	CCC-CC*P3E44	C	8.5	-			8500	71	30.07	50	0	85.0	0	2000	1.4	P																				
		-									2	89.0	0	2000	1.4																				
		-									4	93.0	0	2850	1.4																				
		-									0	90.0	0	2000	1.4																				
		-									2																								
		.									4																								
3	CCCXC1*P2C46	C	8.5	-			7734	71	30.07	52	0	87.0	0	2100	1.0		88.0	0	2100	4.0																
		-									2	87.0	4	2100	1.0		88.0	4	1950	4.0																
		-									4	87.0	0	2800	1.0		87.0	4	1700	4.0																
		-									0	85.0	0	2000	1.0		86.0	0	1900	4.0																
		-									2	86.0	4	1900	1.0		86.0	0	2250	4.0																
		-									4	84.0	0	2250	1.0		84.0	4	1800	4.0																
4	CCCXC1*P2A43	F	8.5	-			15484	71	29.86	50	0	87.0	0	1400	1.0		88.0	0	1400	3.0																
		-									2	88.0	0	1600	1.0		90.0	0	1700	3.0																
		-									4	85.0	0	1400	1.0																				
		-									0	86.0	0	1400	1.0		86.0	0	1400	3.0																
		-									2	87.0	0	1700	1.0		88.0	0	1600	3.0																
		.									4	84.0	0	1900	1.0																				
5	CCCXC1*P2A43	F	8.5	-			7820	64	29.16	54	0																								
		-									2																								
		-									4																								
		-									0																								
		-									2																								
		.									4																								
6	CCCXC1*P2A43	F	8.5	-			9980	47	28.88	50	0																								
		-									2	80.0	0	1900	1.0																				
		-									4																								
		-									0																								
		-									2																								
		.									4																								

1989 DOD OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION									WEATHER			OCTANE NUMBER REQUIREMENT DATA										TANK FUEL INFORMATION						
					SPARK ADVANCE							MAXIMUM					PART-THROTTLE					RATED						
DESIG NO.	MODEL CODE	E M C T	V S	L A I P	I B P	AS RCD	AS TST	ODOM MILES	AMB TMP	BAROM	H2O	F U E L	OCT NO	A P	RPM	LUG	OCT NO	A P	RPM	LUG	C M V	OCT NO	V S	L A I P	RPM	L U G
AF 01	0304Q34*P1CA3	C	-	8.5	-			7350	70	28.86	61	1	90.1	UL	2000	0.0	80.1	UL	1600	10.1						
			-									2	90.1	UL	2000	0.0										
			-									4	79.1	UL	2000	0.0										
			-									1	-													
			-									2	-													
			-									4	78.1	UL	2000	0.0										
AF 04	0304Q34*P1CA3	C	-	8.5	-			8019	70	28.87	61	1	89.1	UL	2000	0.0	86.1	UL	1600	7.1						
			-									2	89.1	UL	2000	0.0										
			-									4	86.1	UL	2000	0.0										
			-									1	86.1	UL	2000	0.0	85.1	UL	1600	7.0						
			-									2	87.1	UL	2000	0.0										
			-									4	86.1	UL	2000	0.0										
19-01	0304Q34*P1DA1	F	-	8.5	-			16751	70	28.77	61	1	89.1	UL	1600	0.6	89.1	UL	1600	8.1			Y			
			-									2	89.1	UL	1600	0.6	87.1	UL	2000	8.0						
			-									4	87.1	UL	1600	0.6										
			-									1	87.1	UL	1600	0.6	89.1	UL	1600	8.1						
			-									2	88.1	UL	1600	0.6	84.1	UL	1600	8.1						
			-									4	84.1	UL	1600	0.6										
19-02	0304W34*P1EA4	F	-	8.5	-			12003	80	28.84	87	1	88.1	AL	1600	1.6	F									
			-									2	90.1	AL	1600	1.6										
			-									4	86.1	AL	1600	1.6										
			-									1	87.1	AL	1600	1.6										
			-									2	87.1	AL	1600	1.6										
			-									4	86.1	AL	1600	1.6										
19-03	0304W34*P1EA4	F	-	8.5	-			9446	70	28.80	61	1	87.1	AL	1600	1.6	84.1	AL	1600	0.6						
			-									2	90.1	AL	1600	1.6										
			-									4	83.1	AL	1600	1.6										
			-									1	84.1	AL	1600	1.6	84.1	AL	1600	0.6						
			-									2	83.1	AL	1600	1.6										
			-									4	80.1	AL	1600	1.6										
19-04	0304W34*P1EA4	F	-	8.5	-			9676	87	28.81	80	1	86.1	AL	1600	1.6	F							Y		
			-									2	87.1	AL	1600	1.6										
			-									4	84.1	AL	1600	1.6										
			-									1	85.1	AL	1600	1.6										
			-									2	86.1	AL	1600	1.6										
			-									4	84.1	AL	1600	1.6										

1989 CFR OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION											WEATHER		OCTANE NUMBER REQUIREMENT DATA								TANK FUEL INFORMATION				
				SPARK ADVANCE									MAXIMUM				DISPLACEMENT				OCTANE				
DESIGN NO.	MODEL CODE	ENGINE CODE	CARB. TYPE	MAN. TRANS.	AUTO. TRANS.	DIST. FOR PEAK TORQUE	DIST. FOR MBT	MBT LESS TWO	BARO PRESS.	ALTITUDE	TEMP.	HUMIDITY	OCTANE NO.	SENSITIVITY	ADJUSTED OCTANE NO.	OCTANE NO.	SENSITIVITY	ADJUSTED OCTANE NO.	OCTANE NO.	SENSITIVITY	GRADE	MTBE	ETBE	TAME	DIPE	TAME
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1989 CFC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION											WEATHER			OCTANE NUMBER REQUIREMENT DATA												TEST FUEL INFORMATION									
														MAXIMUM					PART-THROTTLE							DATES									
				SPARK ADVANCE																															
VEH NO	MODEL CODE	ENGINE CODE	N S	CYL	P R	AS REQ	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	LOT NO	OCT NO	A P	RPM	ADJ	OCT NO	A P	RPM	ADJ	COM NO	MOTR	T	R	S	RPM	ADJ								
1-01	1G4AM1[illegible]P0[illegible]40	P	-	8.0	-			10494	42	29.05	00	1	85.0	GL	1600	1.0	85.0	GL	1600	0.0														
			-									2	86.0	GL	1600	1.0																		
			-									4	80.0	GL	1600	1.0																		
			-									1	80.0	GL	1600	1.0																		
			-									2																						
			-									4																						
2-01	1G4AP0[illegible]T0540	P	N	8.0				17347	72	29.02	60	1	87.0	GL	2000	0.0	86.0	GL	1600	0.0			N												
												2	88.0	GL	2400	0.0																		
												4	90.0	GL	2200	0.0																		
3-01	1G4AP0[illegible]T0540	P	N	8.0	-			21810	72	29.67	60	1	85.0	GL	1600	1.0	84.0	GL	1400	0.0	91.7	92.0	A	M	GL	1400	1.0							
												2	86.0	GL	2600	0.0																		
												4	87.0	GL	2600	0.0																		
4-01	1G4AN1[illegible]P0[illegible]40	P	-	8.0				16826	25	24.79	10	1	84.0	GL	1600	1.0	84.0	GL	1600	0.0														
			-									2	84.0	GL	1600	1.0																		
			-									4	87.0	GL	1400	1.0																		
			-									1	87.0	GL	1600	1.0																		
			-									2																						
			-									4																						
5-01	1G4AN1[illegible]P0[illegible]40	P	-	8.0	-			17836	74	29.15	40	1	84.0	GL	1350	0.0	F						N											
			-									2	90.0	GL	1625	0.0	F																	
			-									4	87.0	GL	1400	1.0	87.0	GL	1600	0.0														
			-									1	90.0	GL	1350	0.0																		
			-									2	87.0	GL	1625	0.0																		
			-									4	87.0	GL	1400	0.0																		
6-01	1G4AN1[illegible]P0[illegible]44	P	-	8.0	-			15579	72	30.19	60	1	82.0	GL	1350	1.4	F																	
			-									2	84.0	GL	2000	1.4																		
			-									4	80.0	GL	1800	1.4																		
			-									1	0.0	GL	2000	1.4																		
			-									2	80.0	GL	2000	1.4																		
			-									4	80.0	GL	1800	1.4																		
7-01	1G4AN1[illegible]P0[illegible]44	P	-	8.0	-			21128	70	29.50	50	1	88.0	GL	1700	0.0	88.0	GL	1550	0.0	90.0	90.4	B	M	GL	1600	0.0							
			-									2	88.0	GL	1600	0.0	88.0	GL	1800	0.0														
			-									4	90.0	GL	1800	0.0																		
			-									1	90.0	GL	1600	0.0	88.0	GL	1550	0.0														
			-									2	91.0	GL	1600	0.0	90.0	GL	1800	0.0														
			-									4	89.0	GL	1700	0.0																		

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	SPARK ADVANCE: A S P.	A S R	A S T	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	F U E L	MAXIMUM OCTANE NO.	G E A R	P	A C	PART-THROTTLE OCTANE NO.	G E A R	P	A C	TANK FUEL INFORMATION: O W N K	OCT NO	K N T	G E A S	P	E	A C
0545	CC44N2*P0344	P -	9.0			17471	70	29.60	52	3	89.0	2L	2100	1.0	P						B	M	2L	2400	1.0
		-								3	91.0	2L	2100	1.0											
		-								4	87.0	2L	2150	1.0											
		-								3	88.0	2L	2100	1.0											
		-								3	90.0	2L	2100	1.0											
		-								4	88.0	2L	2150	1.0											
0545	CC44N2*P0344	P -	9.0			12074	82	29.89	33	3	96.0	4L	1600	1.0	97.0	4L	1600	1.0							
		-								3	95.0	4L	1600	1.0	97.0	4L	1600	1.0							
		-								4	95.0	4L	1600	1.0											
		-								3	95.0	4L	1600	1.0	96.0	4L	1700	1.0							
		-								3															
		-								4															
0545	CC44N2*P0344	P -	9.0			6701	75	29.45	77	3					96.0	4L	1600	6.6							
		-								3					100.0	4L	1600	7.1							
		-								4					96.0	4L	1600	6.6							
		-								3					96.0	4L	1600	6.6							
		-								3															
		-								4															
0545	CC44N2*P0344	P -	9.0			16020	75	30.09	37	3	93.0	3L	1450	1.0	93.0	4L	1450	1.0	N			N			
		-								3	94.0	4L	1400	0.0											
		-								4	93.0	4L	1350	0.0											
		-								3	91.0	3L	1450	1.0											
		-								3	91.0	4L	1400	0.0											
		-								4	90.0	3L	1500	1.0											
0545	CC44N2*P0344	P -	9.0			17045	70	30.07	57	3	97.0	4L	2200	2.0	99.0	4L	1900					N			
		-								3	97.0	4L	2200	2.0											
		-								4	96.0	4L	2000	2.0											
		-								3															
		-								3															
		-								4															
0545	CC44N2*P0344	P -	9.0			19079	69	30.11	0	3	96.0	4L	2000	5.0	95.0	4L	2400	5.0				N			
		-								3	96.0	4L	2000	5.0											
		-								4	95.0	4L	2000	5.0											
		-								3	95.0	4L	2000	5.0											
		-								3	95.0	4L	2450	5.0											
		-								4	95.0	4L	2000	5.0											

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	VEHICLE DESCRIPTION: MODEL CODE	ENGINE CONFIG	ENGINE SIZE	CYL	FUEL SYS	SPARK ADVANCE: AS PCD	AS TST	WEATHER: ODOM MILES	AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: OCT NO	P	RPM	VAC	PART-THROTTLE: OCT NO	P	RPM	VAC	TANK FUEL INFORMATION: OCTANE NO.	PASS	WGTD	P	P	RPM	VAC
05-01	C04WAQXP03A4	F	3.3	6				19030	69	00.00	30	90.0	3	2400	0.5	F										
											2	94.5	3	1200	0.5											
											4	90.5	4	1400	1.0											
											3	91.5	4	1550	1.0											
											2	94.5	3	1900	0.5											
											4	90.5	4	1400	1.0											
04-05	C04WWCXP03A4	F	3.3	6				8001	70	29.75	69	90.0	3	2000	0.0	F										
											2	90.0	3	2000	0.0											
											4	87.0	3	2000	0.0											
											3	88.0	3	2000	0.0	F										
											2	88.0	3	2000	0.0											
											4	87.0	3	2000	0.0											
03-04	C04WTCXPDYA4	F	3.3	6				9798	20	29.46	12	94.0	3	2000	1.5	84.0	3	2000	0.0							
											2	95.0	3	2000	1.5	85.0	3	2000	0.0							
											4	91.0	3	2000	1.5											
											3	90.0	3	2000	1.5											
											2															
											4															
05-04	C04-02XP03A4	F	3.3	6				9588	78	29.97	49	0														
											2															
											4															
											3															
											2															
											1															
05-01	C04-02XP03A4	F	3.3	6				14910	70	29.88	52	90.0	3	2250	1.5	F								B M	3	2250	1.5
											2	85.0	3	2240	1.5											
											4	88.0	3	2300	1.0											
											3	90.0	3	2300	1.5											
											2	94.0	3	2400	1.5											
											4	87.0	2	2000	1.0											
03-14	C04-02XP03A4	F	3.3	6				17154	70	29.28	50	85.0	3	2300	1.0	84.0	3	2000	0.5							
											2	88.0	3	2300	1.0											
											4	83.0	2	1900	0.5											
											3	87.0	3	2300	1.0											
											2	84.0	3	2300	1.0											
											4	79.0	2	2000	0.5											

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

TEST NO.	VEHICLE DESCRIPTION: MODEL CODE	ENGINE CONFIG	ENGINE SIZE	SPARK ADVANCE: MANUAL	SPARK ADVANCE: AUTOMATIC	WEATHER: ODOM MILES	WEATHER: AMB TMP	WEATHER: BAROM	WEATHER: HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: ENGINE SPEED	OCT NO	A/F RATIO	PPM	LAC	OCTANE NUMBER REQUIREMENT DATA: PART-THROTTLE: ENGINE SPEED	OCT NO	A/F RATIO	PPM	LAC	TANK FUEL INFORMATION: OCTANE NUMBER	TANK FUEL INFORMATION: WATER: DOCT NO	TANK FUEL INFORMATION: WATER: MOTOR	TANK FUEL INFORMATION: WATER: GRAVITY	TANK FUEL INFORMATION: WATER: H/C RATIO	TANK FUEL INFORMATION: WATER: PPM	TANK FUEL INFORMATION: WATER: LAC
89-1	CO4-CC*P0344	F	8.6	Y	22800	79	29.60	85	0	91.0	3U	2250	0.6	89.0	4L	1600	1.0										
									2	90.0	3U	2250	0.6														
									4	87.0	3U	2250	0.6														
									0	91.0	3U	2250	0.6														
									2																		
									4																		
89-10	CO4CC1*P0344	F	8.6	Y	16139	71	29.69	80	0	93.0	3U	2400	0.6	93.0	3U	2400	0.0										
									2	92.0	3U	2400	0.6														
									4																		
									0	93.0	3U	2400	0.6														
									2																		
									4																		
89-11	CO5CC1*T4644	F	3.0	Y	+10	+10	16499	71	29.38	80	0	88.0	2U	2350	1.6	86.0	4L	2350	6.6								
									2	87.0	2U	2350	1.6														
									4	85.0	2U	2350	1.6														
89-12	CO5CC1*T4644	F	3.0	Y	+10	+10	17078	81	29.39	104	0	86.0	4L	1650	2.0	85.0	4L	2550	6.0								
									2	86.0	4L	1650	2.0	86.0	4L	2300	6.0										
									4	84.0	4L	1650	2.0														
89-13	CO5CC1*T4644	F	3.0	Y	+10	+10	9509	78	30.19	88	0	86.0	4L	1650	2.0	86.0	4L	2350	4.6								
									2	87.0	4L	1700	2.0	86.0	4L	2450	4.6										
									4	84.0	4L	1750	2.0														
89-14	CO5CC1*T4644	F	3.0	Y	+10	+10	8780	71	29.67	80	0	90.0	4L	1650	1.6	89.6	4L	1600	2.0		91.6	80	1	B	P	4L	15.0	1.6
									2	89.0	4L	1650	1.6														
									4	80.0	4L	1650	1.6														
89-15	CO5CC1*T4644	F	3.0	Y	+11	+10	16894	80	29.69	40	0	90.0	4L	1600	2.0	85.0	3U	2700	4.0								
									2	89.0	4L	1600	2.0	85.0	3U	2700	4.0										
									4	88.0	4L	1600	2.0														
89-16	CO5CC2*T4644	F	8.0	Y	+20	+20	8957	66	30.01	84	0	89.0	3U	2700	1.0	88.0	3L	1600	3.0								
									2	91.0	2U	2700	1.0														
									4	89.0	2U	2200	1.0														
									0	97.0	2U	2700	1.0														
									2																		
									4																		
89-17	CO5CC2*T4644	F	3.0	Y	+10	+10	10307	78	29.67	88	0	90.0	3L	1650	2.0	90.0	3L	2250	4.0								
									2	92.0	3L	1650	2.0	84.0	3L	2750	4.0										
									4	90.0	4L	1750	2.0														

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO	VEHICLE DESCRIPTION: MODEL CODE	VEHICLE DESCRIPTION: ENGINE MFG	VEHICLE DESCRIPTION: ENGINE CODE	VEHICLE DESCRIPTION: ENGINE TYPE	VEHICLE DESCRIPTION: ENGINE SIZE	VEHICLE DESCRIPTION: CYL	VEHICLE DESCRIPTION: C.R.	VEHICLE DESCRIPTION: FUEL SYS	VEHICLE DESCRIPTION: SPARK ADVANCE: AIR	VEHICLE DESCRIPTION: SPARK ADVANCE: PCC	VEHICLE DESCRIPTION: SPARK ADVANCE: TST	VEHICLE DESCRIPTION: ODOM MILES	WEATHER: AMB TMP	WEATHER: BAROM	WEATHER: HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: JET	OCT NO	ENGINE SPEED	HP	RPM	ΔAC	OCTANE NUMBER REQUIREMENT DATA: PART-THROTTLE: JET	OCT NO	ENGINE SPEED	HP	RPM	ΔAC	TANK FUEL INFORMATION: OCTANE NUMBER: KNOCK	OCT NO	MOTR	WATER: KNOCK INT	TIME	AIR	RPM	ΔAC
1	C4CE*4*P*6M5	F	N	9.6	Y	+*C	+*2	*C349	*2	30.05	43	3	90.0	3	3800	0.0	3	90.0	3	4000	0.0	N		92.0	A	M	C			0.0
																	2	91.0	3	3300	0.0		91.0	4	2650	2.0											
																	4	90.0	3	2800	0.0		89.0	3	3100	0.0											
2	C4CE*4*P*6M4	F	N	9.6	Y	+*2	+*2	*6606	*C	29.74	60	3	87.0	3C	2300	0.6	3	84.0	3C	2300	*.5				N												
																	2	87.0	3C	3000	0.6																
																	4	87.0	3C	3C0C	0.6																
3	C4CE*4*P*6M4	F	N	9.6	Y	+*2	+*2	*7C6C	44	29.64	24	3	91.0	4C	2900	0.0	3	89.0	4C	3000	0.0	N	93.4	94.0	N												
																	2	92.0	3C	2350	0.0																
																	4	91.0	4C	2900	0.0																
4	C4C4*2*P*2M4	F	N	9.0	Y	+*5	+*5	*C4C2	46	30.03	41	3	86.0	3C	*700	0.4	3C	86.0	3C	1600	0.4	N															
																	2	89.0	2U	3200	0.4																
																	4	86.0	3C	*600	0.4																
5	C5I4*3*P*6M4	F	N	9.6	Y			6*5C	*5	29.69	32	3	96.0	4C	2450	*.0	4C	94.5	4C	2400	*.6																	
																	2	97.0	3C	3*00	0.6																
																	4	94.0	3C	3*00	0.6																
6	C5I3*2*P*6M4	F	N	9.0	Y	+ 5	+ 5	*5225	*C	29.05	60	3	87.0	3C	3000	0.6	3	86.0	3C	3800	*.5				N												
																	2	87.5	2C	2850	0.6																
																	4	87.0	2C	3000	0.6																
7	C5IM5*2*6M5	F		9.6	Y	+ 5	+ 5	*2264	*C	29.40	*5	3	86.0	4	2000	0.0	4	83.0	4	2*50	*.0	N															
																	2	85.0	4	2050	0.0																
																	4	84.0	4	2975	0.0																
8	C5IM5*2*6M5	F	N	9.5	N	+ 5	+ 5	*7926	*5	29.70	*1	3	88.0	4	2500	0.4	4	88.0	4	2300	2.0																
																	2	88.0	4	3000	0.4																
																	4	89.0	4	2900	0.4																
9	C5IM*2*6*5A0	F	N	9.6	Y	+ 0	+ 0	*0295	*C	29.64	50	3	85.0	3	2000	2.0	3	83.5	3	*900	0.0				N												
																	2	85.0	3	2400	*.6																
																	4	84.0	2	2*00	0.0																
10	C5I*5D*6M5	F	N	9.6	Y	+*C	+*0	6044	*9	29.05	*4	3	87.0	4	2000	0.5	4	87.0	4	2000	3.0																
																	2	88.0	4	2500	0.5																
																	4	87.0	4	2000	0.6																
11	C5I*5D*6A0	F	N	9.6	Y	+*C	+*0	6900	*5	30.07	*2	3	90.0	3C	2900	0.9	3C	88.0	3C	2000	4.6				N												
																	2	91.0	3U	2900	0.9																
																	4	91.0	3C	2900	0.9																
12	C6CE*4*P*6M4	F	N	9.0	N	+*8	+*8	*7648	69	30.00	26	3	96.0	4	*550	0.8	4	95.5	4	*450	0.0	N	95.6	95.*	N												
																	2	96.0	4	*800	0.8																
																	4	95.0	3	*600	*.0																

1988 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	S	A C.R.	SPARK ADVANCE: A P	AS REQ	AS TST	ODOM MILES	WEATHER: AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: F U L	MAXIMUM: G E A R	RPM	VAC	PART-THROTTLE: G E A R	RPM	VAC	TANK FUEL INFORMATION: D W N	OCT NO RES	OCT NO MOTR	N I T	WATER: N - E A R	RPM	VAC
18-19	C83Bx4xT15M5	F	N	9.0	Y	+18	+18	20039	55	30.03	28	1	87.0	4	3800	1.1	87.0	4	2800	4.0	N	88.0	80.4	N			
												2	88.0	4	2700	1.1	89.0	4	3000	4.0							
												4	87.0	4	3800	1.1											
08-19	C83Bx4xT15M5	F	N	9.2	Y	+18	+18	6840	74	30.40	60	1	89.0	4	2000	0.8	F				N	88.8	84.0	N			
												2	90.0	4	1350	0.8											
												4	88.0	4	1900	0.8											
17-17	C83Bx4xT15M5	C	N	9.2	Y	+18	+18	7600	70	29.92	50	1	88.0	3	3250	0.0	87.0	3	3250	1.0							
												2	88.0	3	3000	0.0											
												4	88.0	3	3000	0.0											
07-10	C82Bx4xT15M5	F	N	9.0	Y	+ 8	+ 8	8072	70	29.94	65	1	94.0	4	2200	0.0					N	88.6	82.0	N			
												2	82.0	4	2600	0.0											
												4	92.0	4	2100	0.0											
14-10	C82Ax4xP15M5	C	N	9.0	Y	+14	+14	9192	78	30.00	58	3	80.0	3	850	0.2					N	92.8		N			
												2	84.0	3	900	0.2											
												4	87.0	3	1500	0.2											
17-18	C82Cx4xT20M5	C	N	9.1	Y	+20	+20	8900	70	29.88	50	1	90.0	4	1500	1.0	88.0	4	1500	1.0							
												2	90.0	4	1500	1.0											
												4	90.0	4	1500	1.0											
17-18	C82Cx4xT20M5	F	N	9.1	Y	+15	+15	10240	74	30.07	75	1	88.0	4	2500	0.0	F				N			Y			
												2	88.0	3	3950	0.0											
												4	86.0	4	3500	0.0											
08-18	C82Cx4xT20A4	F	N	9.1	Y	+12	+12	6420	74	29.93	98	1	94.0	4U	1500	1.6	88.0	3U	1800	4.0	N	94.8	81.0	N			
												2	89.0	4U	1710	1.6											
												4	88.0	3U	1560	1.6											
09-10	C82Cx4xT20A4	F	N	9.1	Y	+15	+15	8000	72	29.60	100	1	91.0	4U	2800	1.6	90.0	4U	2800	3.0	N	95.2	85.1	N			
												2	92.0	4U	2800	1.6											
												4	89.0	4U	2800	1.6											
14-15	C82Cx4xP20M5	E	N	9.0	Y	+15	+15	6037	70	29.56	98	1	86.0	3	2875	0.0	84.0	4	1475	0.0	N	94.1	84.6	N			
												2	86.0	3	2775	0.0											
												4	84.0	3		0.0											
17-17	C82Cx4xP20A4	C	N	9.0	Y	+15	+15	8355	73	29.97	58	1	90.0	3U	2400	0.0					N	88.8	83.0	N			
												2	91.0	4U	2800	0.0											
												4	89.0	4U	2400	0.0											
15- 4	C84Ax2xT15M5	F	N	9.4	N	+ 5	+ 5	12550	74	29.92	75	1					100.0	4	1850	9.0	N	88.6	83.8	A	P	4	1700	9.0
												2					100.0	4	1850	9.0							
												4					98.0	4	1850	9.0							

1983 CFR OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION										WEATHER			OCTANE NUMBER REQUIREMENT DATA											TANK FUEL INFORMATION										
														MAXIMUM					PART-THROTTLE																	
						SPARK ADVANCE																															
OBS. NO	MODEL CODE		ENGINE MFR	CID	CARB TYPE	AS REC	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	OCT NO	RPM	MAP	AC	OCT NO	RPM	MAP	AC	COMMENTS	OCT NO	RES	MOTR	SENSITIVITY	GRADE	RPM	AC	GRADE	RPM	AC	GRADE	RPM	AC	GRADE	RPM	AC
28-10	C84AJ2*21543	F	N	3.4	Y	+ 5	+ 5	7552	66	30.47	30	3	89.0	3L	1800	1.4	82.0	3L	2000	3.4	N	93.3	82	7	N										
												2	84.0	3L	1900	1.4	84.0	3L	2000	3.4														
												4	85.0	3L	1900	1.4																		
29-10	C84AJ2*21543	F	N	3.4	Y	+ 5	+ 5	14854	70	29.26	60	3	90.0	3L	1900	2.3	89.0	3L	1900	3.0					N									
												2	91.0	3L	2000	2.3																		
												4	89.0	3L	1900	2.3																		
40-10	C84AJ2*21543	F	N	3.4	N	+ 5	+ 5	8936	72	29.95	61	3	89.0	3L	2100	0.0	86.5	3L	2200	1.5														
												2	89.0	3L	2100	0.0																		
												4	90.0	3L	2200	0.0																		
41-10	C69AX2*P1644	C	N	3.8	Y			26990	75	30.17	60	3	98.0	2L	2450	0.6	93.0	4L	1700	0.6									A	P	4L			0.6
												2	99.0	2L	2300	0.6	89.0	3L	2400	5.6														
												4	97.0	3L	2450	0.6	87.0	3L	2500	5.6														
66-10	C71A*2*P16A4	F	N	3.8	N	+ 2	+ 2	15450	74	29.81	75	3	91.0	3L	2100	0.6	F																		
												2	91.0	3L	2100	0.6																		
												4	87.5	3L	2400	0.6																		
47-10	C71B*2*P22M5	C	N	3.6	Y	+ 5	+ 5	14600	70	29.95	60	3	88.0	4	1200	1.6	86.0	4	1200	1.6	N	91.0	88	0	N										
												2	88.0	4	1200	0.6																		
												4	87.0	4	1300	0.6																		
39-10	C71D*2*P0244	F	N	3.6	Y	+ 5	+ 5	11020	70	29.67	50	3	88.0	3L	2700	0.2	F																		
												2	87.5	3L	2800	0.2																		
												4	86.0	3L	2900	0.2																		
39-10	C71D*2*P0244	F	N	3.6	Y	+ 5	+ 5	8716	70	29.67	61	3	88.0	4L	1425	1.1	F																		
												2	90.0	3L	2050	1.1																		
												4	85.0	4L	1600	1.1																		
47-10	C71B*2*P0144	C	N	3.2	Y	+ 9	+ 9	7628	75	30.13	50	2	91.0	4	2100	0.0													B	M	2	2200		0.0
												2	92.0	4	2100	0.0	91.0	3	2500	2.0														
												4	90.0	4	2350	0.0	90.0	4	1750	5.0														
47-10	C71B*2*P0144	C	N	3.2	Y	+12	+ 9	7800	70	30.00	50	3	93.0	3	2300	0.0	87.0	3	2300	1.2														
												3	99.0	3	2400	0.0																		
												4	88.0	3	2300	0.0																		
47-10	C78A*2*T16M5	C	N	3.4	Y	+ 3	+ 7	15132	73	30.04	55	3	98.0	3	1700	1.5	88.0	3	1400	6.0	N								B	P	4	2400		1.0
												2	96.0	4	2200	0.5	87.0	3	2400	1.5														
												4	98.0	4	1650	0.5	87.0	4	1500	6.0														
24-10	C78A*2*T16A3	F	N	3.4	Y	+ 7	+ 7	15793	70	29.44	60	3	97.0	2L	2000	0.5	86.0	2L	1900	1.5														
												2	97.0	2L	2000	0.5																		
												4	96.0	2L	2000	0.5																		

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	MODEL CODE	VEHICLE DESCRIPTION: ENGINE TYPE	ENGINE SIZE	CYL	AIR INDUCTION SYSTEM	SPARK ADVANCE ADJUSTABLE	SPARK ADVANCE AUTOMATIC	ODOM MILES	WEATHER: AMB TMP	BAROM	HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: FUEL	OCT NO	RPM	AC	PART-THROTTLE: FUEL	OCT NO	RPM	AC	TANK FUEL INFORMATION: OCTANE NO	PES	MOTR	WATER: PRESENT	DRAIN	DRAIN RPM	AC
81-10	C*81x3x*7*8A3	F	9.4	V				8450	70	29.65	50	3	85.0	2L	2800	0.4	90.0	2L	2400	6.0				N		
												1	96.0	3L	2000	1.4	95.0	2L	2400	6.6						
												4															
81-07	C*8Ax3x*7*8A3	F	9.4	V	-	-	-	11750	75	29.81	69	3	88.0	3L	2000	0.0	88.0	3L	2500	1.0						
												1	85.0	3L	2500	0.0										
												4	87.0	3L	2550	0.0										
81-08	C*80x3x*7*8M3	F	9.4	-				40366	70	29.56	71	3	87.0	3	2600	0.0	F							-		
												1	88.0	3	2600	0.0										
												4															
87-*1	C*88x3x*P24M3	F	9.6	-				*3*7	70	30.*3	66	3					88.0	4	2200	*0.0	N	86.8	86	0	N		
												1					88.0	4	2200	*0.0							
												4					86.0	4	2500	*2.0							
87-**	C*88x3x*P14A4	C	9.*	N	+*5	+*5		28800	70	29.80	50	3	91.0	4L	2500	0.6	88.0	4L	2500	5.0						
												1	91.0	4L	2500	0.6										
												4	88.0	4L	2500	0.6										
89-07	C*8Ex2x*D2M3	F	-	9.0	-			807*	6*	29.93	59	3	86.0	4	*000	0.4	84.0	4	*000	*.4	N				N		
			-									1	86.0	4	*000	0.4										
			-									4	85.0	3	*000	0.4										
			-									3															
			-									1															
			-									4															
89-*1	C*8Ex2x*P3C44	F	-	9.0	-	+*5	+*5	*8898	7*	30.04	50	3	88.0	2L	2800	*.6	F								N		
			-									2	9*.0	2L	2800	*.6										
			-									4	85.0	2L	2900	*.6										
			-									3	88.0	2L	2800	*.6										
			-									2	90.0	2L	2800	*.6										
			-									4	85.0	2L	2900	*.6										
87-14	C*8Ex2x*P3C44	C	-	9.0	V	+*5	+*5	8800	74	30.01	66	3	87.0	2L	2*00	*.0					N	90.6	92.*	N		
			-									2	89.0	2L	2900	*.0										
			-									4	88.0	2L	2*00	*.0										
			-									3															
			-									1															
			-									4															

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO.	MODEL CODE	EM CT	A S	SPARK ADVANCE A IP	AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	H-M	E L	MAXIMUM OCT NO	G E A R	RPM	VAC	PART-THROTTLE OCT NO	G E A R	RPM	VAC	TANK FUEL INFORMATION OCT NO	WATER				
80-01	D7B5X1XP0144	P	H	3.0	+		7858	70	29.57	58	0	92.0	2L	2800	0.4	P					N				
											2	84.0	2L	2400	0.4	84.0	2L	2400	0.4						
											4															
83-02	D7B5B2XP1BA0	P	N	3.0	+	+10	+10	7406	70	29.60	60	0	90.5	2L	2850	0.4	87.5	2L	2000	1.5	92.5	94		N	2L
											2	92.5	2L	2000	0.4									
											4	92.5	2L	2000	0.4									
84-03	D7B5B2XP1BA0	C	N	3.0	+	+10	+10	10824	70	30.10	57	0	88.0	2L	2800	0.0						N			
											2	88.0	2L	2800	0.0									
											4	84.0	2L	2000	0.0									
87-04	D88B04XP0144	P	H	3.0	+			6044	70	30.11	42	0										N	86.0	86.0	N	
											2	80.0	4	1200	0.0									
											4	78.0	4	1800	0.0									
88-05	C8C04XP1B40	P	N	3.0	+	+20	+20	11304	70	29.87	50	0	87.0	2	2400	0.0	87.0	2	2400	1.0				N	
											2	87.0	2	2000	0.0									
											4	86.0	2	2800	0.0									
89-06	C8C04XP1B40	P	N	3.0	+	+20	+20	10702	70	29.46	50	0	88.0	2	2000	1.0	82.0	2	2000	6.0					
											2	87.0	2	2400	1.0	88.0	2	2000	6.0					
											4	88.0	2	2800	1.0									
81-07	C844E0XP1BM4	C	N	3.0	N	+	0	+	0	6378	74	30.08	52	0	91.0	4	1250	0.0	90.0	4	1000	8.0	N			N	P	0		0
											2	90.0	4	1400	0.0	90.0	4	1200	8.0						
											4	90.0	4	1400	0.0	91.0	4	1200	8.0						
84-08	C844E0XP1B40	P	N	3.0	+	+	0	+	0	16159	75	30.15	44	0	87.0	2L	2200	1.0	84.0	2L	2050	8.0				N				
											2	88.0	2L	2600	1.0									
											4	86.0	2L	2800	1.0									
79-09	C844E0XP1B40	P	N	3.0	+	+	0	+	0	13069	76	29.98	48	0	90.0	2L	2750	1.0	P							N				
											2	91.0	3D	2000	1.0									
											4	88.0	2L	2000	1.0									
82-10	C844E0XP1B40	P	N	3.0	+			10005	70	29.42	54	0	90.0	2L	2000	1.0								N	
											2	92.0	2L	4600	1.0									
											4														
85-11	C844E0XP1B40	P	N	3.0	N	+	0	+	0	15250	74	29.80	60	0	91.5	2L	4000	0.5	88.5	2L	2000	1.5								
											2	92.0	2L	4000	0.5									
											4	87.5	2L	2800	0.5									

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS NO	VEHICLE DESCRIPTION: MODEL CODE	ENGINE CONFIG	ENGINE FAMILY	EVAP CANISTER	SPARK ADVANCE: AUTO	SPARK ADVANCE: MAN	ODOM MILES	WEATHER: AMB TMP	WEATHER: BAROM	WEATHER: HUM	FUEL	MAXIMUM: OCT NO	MAXIMUM: SENSITIVITY	MAXIMUM: RPM	MAXIMUM: LAC	PART-THROTTLE: OCT NO	PART-THROTTLE: SENSITIVITY	PART-THROTTLE: RPM	PART-THROTTLE: LAC	TANK FUEL INFORMATION: OXYGENATE PRESENT	TANK FUEL INFORMATION: OXYGENATE TYPE	WATER: PRESENT	WATER: TYPE	WATER: SENSITIVITY	WATER: RPM	WATER: LAC
19-07	D34B44X01843	F	N	8.5	+	+ 5	+ 5	8042	80	28.96	64	0	87.0	DL	2050	1.5	84.0	DL	2100	1.5			N			
												2	87.0	DL	2100	1.5										
												4	86.0	DL	2050	1.5										
19-10	D34B44X01843	F	N	8.5	+	+ 5	+ 5	7837	70	28.85	75	0	84.0	DL	2100	1.8	80.0	DL	2800	0.8			N			
												2	85.0	DL	2750	1.1										
												4	84.0	DL	2750	1.8										
22-07	D34B44X01843	F	N	8.5	+	+ 5	+ 5	14754	70	28.87	80	0	87.0	DL	2650	1.0	86.5	DL	2800	0.5			N			
												2	86.5	DL	2700	1.0										
												4	86.0	DL	2000	1.0										
22-10	D34B44X01843	F	N	8.5	+			16219	50	28.86	50	0	88.0	DL	3400	1.6	F						N			
												2	84.0	DL	3400	1.6										
												4															
27-15	D34B44X01843	C	N	8.5	+	+ 5	+ 5	10800	70	28.85	60	0	89.0	DL	4050	0.8	85.0	DL	2250	0.0						
												2	90.0	DL	4050	0.8										
												4	88.0	DL	3700	0.8										
30-15	D34B34XP0144	F	N	8.0	+			16476	70	28.82	77	0	92.0	DL	3400	0.8	L						N			
												2	84.0	DL	3450	0.4										
												4															
34-10	D34B34XP0144	F	N	8.0	+			9606	67	28.80	42	0	92.0	DL	1800	4.0	90.0	DL	2800	6.0						
												2	94.0	DL	1800	4.0	86.0	DL	2850	6.0						
												4	88.0	DL	1800	4.0	88.0	DL	2800	6.0						
38-10	D34B44XP0144	F	N	8.0	+	+10	+10	14830	70	28.80	60	0	86.0	DL	2600	0.5	85.0	DL	2800	1.7			N			
												2	85.0	DL	3000	0.5										
												4	84.0	DL	2600	0.5										
41-10	D34B44XP0144	F	N	8.0	+	+10	+10	16029	70	28.88	60	0	89.0	DL	2400	0.7	88.0	DL	2800	1.7			N			
												2	87.0	DL	2200	0.7										
												4	86.0	DL	2400	0.7										
41-15	D34C34XP0146	F	N	8.0	+			9260	70	28.86	76	0	90.0	D	3700	1.8	L						N			
												2	82.0	D	3800	1.8										
												4															
47-15	D34C34XP0146	C	N	8.0	+	+12	+12	17450	70	28.86	48	0	90.0	4	1700	0.2	89.0	4	1700	1.2						
												2	90.0	4	1700	0.2										
												4	90.0	4	1600	0.2										

1989 CFG OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	VEHICLE DESCRIPTION: MODEL CODE	E M C T	A I R	SPARK ADVANCE: A S P	A S T	WEATHER: ODOM MILES	AMB TMP	BAROM	H U M	F U E L	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM OCT NO	S E N S	RPM	LOAD	PART-THROTTLE OCT NO	S E N S	RPM	LOAD	TANK FUEL INFORMATION: C W N OCT NO	RATED: N A N OCT NO	S E N S	RPM	LOAD
80-09	C34PM4*P00A4	P	-	3.0	+	17809	70	29.54	74	3											N		
			-							3	90.0	3L	0700	1.0									
			-							4													
			-							3													
			-							2													
			-							4													
80-10	C34PM4*P00M3	P	-	3.0	+	7840	70	29.67	74	3	86.0	3	0300	1.0	P						N		
			-							2	86.0	3	0800	1.0									
			-							4													
			-							3													
			-							2													
			-							4													
80-11	C36P42*P*BM3	P	-	10.0	+	+ 2	+ 2	1400	80	29.93	101	3				88.0	3	4800	2.5	+		B P A	0000	0.0
			-							2	90.0	3	4800	0.4	94.0	3	4800	2.5					
			-							4	88.0	4	1400	0.4	88.0	3	0000	2.5					
			-							3					-									
			-							2														
			-							4														
80-12	C36P42*P*BA3	C	-	10.0	+			9894	78	30.00	97	3	100.0	2	1800	0.5	88.0	3	1800	4.5	N		A P C		0.0
			-							2	100.0	3	0000	0.5	89.0	3	2400	4.0					
			-							4	89.0	3	2600	0.5									
			-							3	94.0	3	2600	0.5	85.0	3	2450	4.5					
			-							2	96.0	2	2700	0.5	88.0	3	2800	4.0					
			-							4	94.0	3	2600	0.5									
80-13	C36*X1*P0A4	P	-	9.0	+			15069	70	29.46	80	3	86.0	2	2100	0.5	88.0	3	2100	3.0			N		
			-							2	86.0	3	2100	1.0									
			-							4	85.0	3	2100	1.0									
			-							3	84.0	2	2000	0.5	85.0	3	2100	3.0					
			-							2	84.0	2	2000	0.5									
			-							4	83.0	2	2000	0.5									
80-14	C36B*X*P2BA4	P	N	9.0	+	+12	+12	15840	70	29.40	80	3	86.5	3L	1450	0.4	P						N		
										2	86.0	3L	1800	0.5									
										4	84.0	2U	1550	0.4									
80-15	C*2B*X*P2B42	P	N	9.0	+	+12	+12	19876	70	29.62	80	3	84.0	2	2000	0.5	85.0	3	2300	3.0			N		
										2	85.0	3	2400	0.5									
										4	84.0	3	2600	0.5									

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO	MODEL CODE	EMC T	TS	DISPL	DP	AS PCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	MAX OCT NO	GEAR	RPM	VAC		P-T OCT NO	GEAR	RPM	VAC	KNOWN	RES	MOTR	RATER	GEAR	RPM	VAC
09-00	[illegible]	A	[illegible]	7.5	[illegible]	+10	+10	10488	80	29.33	60	3	84.0	2	3100	-4.5		83.0	3	2660	-1.5				N			
			-									1	85.0	2	3050	-4.5		80.0	3	2450	-1.5							
			-									4	84.0	2	3000	-4.5												
			-									3	83.0	2	2400	-4.5												
			-									1	80.0	2	3000	-4.5												
			-									4	80.0	2	3000	-4.5												
65-17	[illegible]P0044	F	N	3.8	[illegible]	+10	+10	6260	65	29.40	81	3						87.0	4L	1750	5.0							
												1						88.0	4L	1750	5.0							
												4						84.0	4L	1750	4.5							
09-15	[illegible]P0044	F	N	3.8		+10	+10	15007	66	29.39	48	3	90.0	3L	2600	0.5		87.0	4L	1500	2.0				N			
												1	91.0	3L	2400	0.5												
												4	88.0	3L	2100	0.5												
09-10	[illegible]T0340	F	N	3.0		+10	+10	14843	70	29.50	60	3	87.0	3L	1900	0.5		86.0	3L	1500	0.5				N			
												1	88.0	3L	1800	0.5												
												4	86.0	3L	1800	0.5												
09-00	[illegible]T0044	E	N	3.0	[illegible]			11693	77	30.19	110	3	91.5	3L	3000	0.0		90.0	4L	1800	0.5	N	88.8	88.5	N			
												1	93.0	3L	3000	0.0	F											
												4	90.5	3L	1900	0.0	F											
09-08	[illegible]T0044	E	N	3.0	[illegible]			6000	80	29.40	85	3	40.0	3L	2600	1.0		90.0	3L	2500	0.0							
												2	94.0	3L	3000	0.0	F											
												4	90.5	3L	2000	0.5	F											
09-11	[illegible]T0344	F	N	3.0	[illegible]			13671	75	29.96	88	3	90.0	3L	2000	0.7		91.0	4L	2000	0.5							
												2	94.0	3L	2000	0.7	F											
												4	91.0	4L	1700	0.0	F											
09-19	[illegible]P0044	F	N	3.8	[illegible]	+10	+10	11519	77	29.30	38	3	86.0	3L	2050	1.5		80.0	4L	1700	4.0				N			
												1	88.0	3L	2000	1.5												
												4	84.0	3L	2600	1.0												
[illegible]-15	[illegible]P0044	C	N	3.8	[illegible]	+10	+10	6097	73	30.10	57	3	87.0	3L	2100	1.0						N			N			
												2	88.0	3L	2250	1.0												
												4	86.0	3L	2050	1.0		85.0	4L	1700	2.5							
[illegible]-05	[illegible]P0044	E	N	3.8	[illegible]	+12	+12	7480	71	29.42	97	3	85.0	3L	2850	1.0	F					N	85.4	88.6	N			
												2	88.0	3L	2800	1.0												
												4	81.0	3L														
09-1[illegible]	[illegible]5M52[illegible]T05M5	E	N	[illegible]				10002	77	30.19	110	3	90.0	4	3000	1.0	F					N	93.[illegible]	88.5	B	M 4	2800	[illegible]
												2	91.0	4	3200	1.0	F											
												4	88.0	4	3100	1.0	F											

1992 CPG OCTANE NUMBER REQUIREMENT SURVEY

OBS NO	VEHICLE DESCRIPTION MODEL CODE	E M C N T S	A I R P	SPARK ADVANCE AS PCT	AS TST	WEATHER DBCOM MILES	AMB TMP	BAROM	E N G	OCTANE NUMBER REQUIREMENT DATA MAXIMUM OCT NO	R	SENS	K FACTOR	DISTRIBUTION OCT NO	R	SENS	K FACTOR	TANK FUEL INFORMATION C W N DCT NO	N G I T E N A R S	PETER PRS	MOTR	T R E	SENS	K FACTOR
08-08	SYSTEM#P4044	P - -	8.8	+		10349	66	00.10	88	1 88.0	4L	1800	0.4	88.0	4L	1700	1.8	N	88.0	88.0	B	M	4L	1800	0.4
		-								2 86.0	4L	1600	0.4	86.0	4L	1580	1.4							
		-								4														
		-								1 88.0	4L	1700	1.8											
		-								2														
		-								4														
07-00	SYSTEM#P4044	P - -	8.8	+		10446	70	00.08	87	1 100.0	2L	1800	0.8	100.0	2L	1700	4.0	N			P	4L		1.0
		-								2 100.0	4L	1400	0.8	100.0	2L	1800	4.0							
		-								4 -	4L	1480	0.8	-	4L	1800	0.0							
		-								1 100.0	2L	2000	0.8	100.0	2L	2000	4.0							
		-								2 86.0	4L	1600	0.8	86.0	2L	2000	4.0							
		-								4 -	4L	1480	0.8	-	4L	1800	0.0							
08-12	SYSTEM#P4044	P - -	8.8	+		10170	76	00.08	82	1 86.0	2L	2000	0.0	84.0	2L	1800	1.8	N	87.8	82.0	N			
		-								2 86.0	2L	2000	2.0	P										
		-								4 84.0	4L	1480	0.8	P										
		-								1 86.0	2L	2000	2.0	88.0	2L	1800	1.8							
		-								2 86.0	2L	2000	0.0	-										
		-								4 84.0	4L	1480	0.8	P										
08-1	SYSTEM#P4044	P - -	8.8	+		9981	78	00.08	80	1 87.0	2L	2000	0.0	88.0	2L	2000	1.0	N	90.8	84.0	N			
		-								2 86.0	2L	2000	0.0	P										
		-								4 86.0	2L	2000	0.8	P										
		-								1 86.0	2L	2000	0.0	86.0	2L	2000	1.0							
		-								2 86.0	2L	2000	0.0	P										
		-								4 86.0	2L	2000	0.8	P										
08-0	SYSTEM#P4044	P - -	8.8	+		9651	78	00.40	70	1 86.0	2L	2000	0.0	P				N	87.4	87.0	N			
		-								2 86.0	2L	2000	0.0	P										
		-								4 88.0	4L	1800	0.8	P										
		-								1 84.0	2L	2000	0.0	P										
		-								2 86.0	2L	2000	0.0	P										
		-								4 88.0	4L	1800	0.0	P										
08-17	SYSTEM#P4044	P - -	8.8	+		7150	76	00.00	112	1 87.0	2L	2000	0.8	P				N	88.0	86.0	N			
		-								2 88.0	2L	2000	0.8	P										
		-								4 86.0	2L	2000	0.8	P										
		-								1 85.0	2L	2000	0.8	P										
		-								2 87.0	2L	2000	0.8	P										
		-								4 85.0	2L	2000	0.8	P										

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION	WEATHER	OCTANE NUMBER REQUIREMENT DATA — MAXIMUM	OCTANE NUMBER REQUIREMENT DATA — PART-THROTTLE	TANK FUEL INFORMATION
[illegible]	[illegible]	86.0 [illegible]	84.5 [illegible]	[illegible] 91.8 [illegible]
		84.0 [illegible]		
		85.0 [illegible]		
		85.0 [illegible]	84.5 [illegible]	
		85.0 [illegible]		
		85.0 [illegible]		
[illegible]	[illegible]	87.0 [illegible]	86.0 [illegible]	[illegible] 94.6 [illegible]
		89.0 [illegible]		
		86.0 [illegible]		
		85.0 [illegible]	86.0 [illegible]	
		87.0 [illegible]		
		85.0 [illegible]		
[illegible]	[illegible]	80.5 [illegible]	80.0 [illegible]	[illegible]
		80.0 [illegible]		
		80.5 [illegible]		
		80.5 [illegible]	80.0 [illegible]	
		80.0 [illegible]		
		80.5 [illegible]		
[illegible]	[illegible]		80.0 [illegible] 1450	
			84.0 [illegible] 1450	
		80.0 [illegible] 1450	80.0 [illegible] 1450	
			80.0 [illegible] 1450	
[illegible]	[illegible]	80.0 [illegible]	86.0 [illegible]	
		88.0 [illegible]	86.0 [illegible]	
		87.0 [illegible]		
[illegible]	[illegible]	91.0 [illegible]	91.0 [illegible]	[illegible]
		80.0 [illegible]		
		91.0 [illegible] 1800		
[illegible]	[illegible]	86.5 [illegible]	88.0 [illegible]	[illegible]
		88.0 [illegible] 1050	88.0 [illegible] 1200	
		85.5 [illegible]	87.0 [illegible]	
[illegible]	[illegible]	80.0 [illegible] 1500	80.0 [illegible] 1500	[illegible] 91.0 80.0 [illegible]
		80.0 [illegible] 1500	80.0 [illegible] 1450	
		80.0 [illegible] 1500	80.0 [illegible] 1400	

1983 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION									WEATHER			OCTANE NUMBER REQUIREMENT DATA									TANK FUEL INFORMATION							
													MAXIMUM				PART-THROTTLE							RATER				
OBS NO	MODEL CODE	EMC T	S	C.R.	A T R	SPARK ADVANCE AS RCD	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	OCT NO	GEAR	RPM	AC	OCT NO	GEAR	RPM	VAC	OWN	OCT NO RES	MOTR	K N T	T	GEAR	RPM	AC
[illegible]	01Y8TO*R03M5	F	N	8.0	Y	+10	+10	8800	70	29.18	50	0	92.0	4	1300	0.5	92.0	4	1300	1.5								
												2	92.0	4	1300	0.5												
												4	90.0	4	1300	0.5												
[illegible]	01Y8TO*R03A4	F	N	8.0	Y	+10	+10	25008	55	30.14	35	0	88.0	2L	3600	0.5	87.0	4L	1725	0.0				N				
												2	91.0	2L	3600	0.5												
												4	88.0	2L	3400	0.5												
[illegible]	[illegible]*R00M5	F	N	8.0	Y	+10	+10	34660	70	29.41	50	0	88.0	4	2700	0.8	88.0	0	4800	0.0	Y	90.0	80.4	B	R	0	4100	0
												2	90.0	4	2800	0.5	90.0	0	4800	0.0								
												4	88.0	4	2800	0.8	92.0	0	4800	0.0								
[illegible]	[illegible]*R00A4	F	N	8.0	Y	+10	+10	28058	70	29.82	45	0	95.0	4L	1800	0.8	95.0	4L	1800	8.0		91.8	81.8	A	M	4L	1800	[illegible]
												2	95.0	4L	1800	0.8	95.5	4L	1800	8.0								
												4	93.0	4L	1800	0.8												
[illegible]	[illegible]*R00A4	C	N	8.0	Y	+10	+10	6018	70	30.02	57	0	88.0	4L	2500	0.4	88.0	4L	1700	0.0	N	91.8	83.8	B	M	3L	2500	0.4
												2	88.0	4L	2400	0.4	90.0	4L	1800	0.8								
												4	87.0	4L	1500	0.5	86.0	3L	2400	0.0								
[illegible]	[illegible]*R00A4	F	N	8.0	Y	+10	+10	14800	70	29.28	50	0	90.0	4L	1400	1.5	91.0	4L	1500	8.0				B	M	3L	2800	
												2	94.0	3L	4100	0.7												
												4	92.0	4L	1500	1.5												
[illegible]	[illegible]*R00A4	F	[illegible]	8.0	Y	+8	+8	17088	70	29.87	50	0	88.0	4L	2000	1.0	84.0	4L	2100	0.0	N	90.0	80.0	N				
												3	90.0	4L	2100	1.0	90.0	4L	2000	0.0								
												4	88.0	4L	2000	1.0	88.0	4L	2100	0.0								
[illegible]	[illegible]*R00A4	F	N	8.0	Y	+10	+10	19164	70	29.05	50	0	88.0	4L	2100	1.0	88.0	4L	2000	0.0	N	95.4	84.8					
												2	90.0	4L	2000	1.0	90.0	4L	2300	0.0								
												4	88.0	4L	2150	1.0	88.0	4L	2000	0.0								
[illegible]	[illegible]*R00A4	F	N	8.0	Y	+10	+10	8787	70	29.85	84	0	90.0	4L	1750	0.5	90.0	4L	1750	1.5	N			N				
												2	85.0	3L	1750	0.0												
												4	91.0	4L	1750	0.5												
[illegible]	[illegible]*R00A4	C	N	8.8	Y	+10	+10	8000	70	30.00	57	0	91.0	3L	4000	0.2	90.0	4L	2000	0.0	N			N				
												2	93.0	3L	4200	0.0												
												4	88.5	3L	4100	0.0												
[illegible]	01 8N0*R5A4	F	-	8.0	Y	+10	+10	10770	68	30.54	60	0	91.0	4	1300	0.0	90.0	3	1400	7.0	N	95.4	84.0	N				
		-										2	92.0	4	1600	0.0												
		-										4	90.0	4	1500	0.0												
		-										0																
		-										2																
		-										4																

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION									WEATHER			OCTANE NUMBER REQUIREMENT DATA								TANK FUEL INFORMATION							
					SPARK ADVANCE								MAXIMUM				PART-THROTTLE								RATED			
TEST NO.	MODEL CODE	ENGINE CYL	ENGINE DISPL.	CARB. TYPE	AS REC	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL TYPE	OCT NO	GRADE	RPM	LAC	OCT NO	GRADE	RPM	LAC	OCTANE NO.	MTBE	TYPE	GRADE	RPM	LAC
1																											
2																											
3																											
4																											
5																											
6																											
7																											
8																											
9																											
10																											
11																											
12																											
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25																											
26																											
27																											
28																											
29																											
30																											

1993 CPC OCTANE NUMBER REQUIREMENT SURVEY

OBS. NO.	MODEL CODE	VEHICLE DESCRIPTION: E M C T	K S	A I R	SPARK ADVANCE: AS POS	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	WEATHER: F L E	MAXIMUM: OCT NO	G A R	RPM	LAC	PART-THROTTLE: OCT NO	G A R	RPM	LAC	TANK FUEL INFORMATION: O W N	OCT NO	A N T I	G A S	RATED: N H P	G A S	RPM	LAC
48-10	JC1EN2*P5744	E -	3.0	*	+10	+10	17070	85	29.50	79	0	90.0	4	1800	1.0	90.0	4		4.0	*				B	P	4	1850	1.0
		-									2	90.0	4	1250	1.0	90.0	4	1250	4.0								
		-									4	88.0	4	1250	1.0												
		-									0	92.0	4	1350	1.0	92.0	4		4.0								
		-									2	90.0	4	1350	1.0	90.0	4	1250	4.0								
		-									4	92.0	4	1350	1.0												
38-20	DC6SP2*T3M6	F -	3.3	*	+10	+10	3074	70	30.16	60	0	92.0	4	1800	1.0	F				N	88	T	88.0	N				
		-									2	94.0	4	1800	1.0												
		-									4	88.0	4	1350	1.0												
		-									0	91.0	4	1800	1.0												
		-									2	92.0	4	1800	1.0												
		-									4	88.0	4	1250	1.0												
38-17	DC6PA2*S744	F -	3.1	*	+ 0	+ 0	10340	88	30.38	44	0	91.0	2L	1800	0.6	88.0	3L	1800	4.0	N	84.0	92.4	B	M	2L	1800	0.6
		-									2	89.0	2L	1800	0.6												
		-									4	90.0	2L	1750	0.6												
		-									0	89.0	2L	1800	0.6												
		-									2	92.0	2L	1750	0.6												
		-									4																
38-5	DC6PA2*S744	F -	3.1	*	+ 0	+ 0	11120	70	29.88	60	0	88.0	2L	1800	0.6	88.0	3L	1800	2.0								
		-									2	86.0	2L	2000	0.6												
		-									4	88.0	2L	1850	0.6												
		-									0	87.0	2L	1800	0.6	84.0	3L	1800	2.0								
		-									2	87.0	2L	2000	0.6												
		-									4	86.0	2L	1750	0.6												
38-16	DC6PA2*S744	F -	3.1	*	+ 0	+ 0	17004	66	29.09	82	0	90.0	2L	2000	1.0	90.0	2L	1700	0.0								
		-									2	88.0	2L	2000	1.0												
		-									4	87.0	2L	2000	1.0												
		-									0	88.0	2L	2000	1.0												
		-									2																
		-									4																
41-15	JC6M2*T43A4	C -	3.0	*	+ 0	+ 0	7696	75	30.02	30	0	94.0	2L	2150	0.6					N			B	M	2L	2150	0.6
		-									2	94.0	2L	1900	0.6												
		-									4	94.0	2L	1850	0.6												
		-									0	93.0	2L	2000	0.6												
		-									2	92.0	2L	1850	0.6												
		-									4	91.0	4L	1850	1.0												

1993 CRC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION								WEATHER			OCTANE NUMBER REQUIREMENT DATA								TANK FUEL INFORMATION							
												MAXIMUM				PART-THROTTLE										
					SPARK ADVANCE																					
OBS. NO.	MODEL CODE	E M C T	A I R	AS REQ	AS TST	ODOM MILES	AMB TMP	BAROM	HUM	F U E L	OCT NO	R	RPM	VAC	OCT NO	R	RPM	VAC	O M N K	OCT NO	MOTR	S E N S	G I V E N	RATED RPM	OC
10-05	J08A2W*8744	P	A			0	0	10690	86	29.71	40	3	86.0	SL	2400	0.6	84.0	4L	1600	0.0						
												2	86.0	SL	2400	0.6										
												4	84.0	SL	2200	0.6										
												1	86.0	SL	2400	0.6										
												2															
												4															
47-05	P05SE2W*8845	C	N			0	0	14705	83	30.01	46	3	94.0	4	4200	0.8	84.0	4	1200	0.0	2			B	M	4	4400	0.6
												2	96.0	4	4600	0.8										
												4	93.0	4	4400	0.8										
33-05	P05SE2W*8844	P	N			0	0	7190	49	28.80	29	3	94.0	SL	2400	1.0	84.0	SL	2000	0.0						
												2	96.0	SL	2600	1.0										
												4	96.0	SL	2400	1.0										
48-05	P05C02W*8405	E	A			0	0	27480	70	29.00	72	3	88.5	4		1.0	88.5	4		1.0	N	87.0	80.5	B	M	2	2375	1.0
												2	88.5	4		1.0	88.5	4		1.0								
												4	88.0	4	4700	1.0												
												1					88.5	4		1.0								
												2	88.5	4		1.0	88.5	4		1.0								
												4	88.0	4	4700	1.0												
22-05	P05C02W*8745	P	A			0	0	6870	24	28.88	14	3	88.0	SL	2750	1.0	87.0	SL	1800	0.0						
												2	88.0	SL	2750	1.0										
												4	88.0	SL	2550	1.0										
												1	88.0	SL	2750	1.0										
												2															
												4															
46-05	P05C02W*8744	P	A			0	0	6060	65	29.40	30	3	89.0	SL	2200	1.0	86.5	SL	2350	0.6						
												2	90.0	SL	2450	1.0										
												4	87.0	SL	2200	1.0										
												1	89.0	SL	2200	1.0										
												2															
												4															
17-05	P05C02W*8744	P	A			0	0	11032	72	30.09	60	3	93.0	SL	2300	1.0					N	93.5	83.6	B	M	SL	2300	1.0
												2	92.0	SL	2500	1.0										
												4	91.0	SL	2300	1.0										
												1															
												2															
												4															

1989 CPG OCTANE NUMBER REQUIREMENT SURVEY

TEST NO.	VEHICLE DESCRIPTION: MODEL CODE	EMI	SPARK ADVANCE: AUTO	SPARK ADVANCE: MAN TEST	WEATHER: ODOM MILES	WEATHER: AMB TMP	WEATHER: BAROM	WEATHER: HUM	OCTANE NUMBER REQUIREMENT DATA: MAXIMUM: PART	OCT NO	RPM	MAP	OCTANE NUMBER REQUIREMENT DATA: PART-THROTTLE: PART	OCT NO	RPM	MAP	TANK FUEL INFORMATION: OCT NO	TANK FUEL INFORMATION: FUEL PES	TANK FUEL INFORMATION: FUEL MOTR	TANK FUEL INFORMATION: PURGE	PURGE RPM	PURGE MAP
08-01	038TDX*43A4	P	3.0	0	9600	81	00.06	39	1	87.0	4L	2200	0.4	L				N	91.0	88.7	N		
									2	84.0	2U	1900	0.4										
									4	80.0	4L	2000	0.4										
									1	87.0	4L	2000	0.4										
									2	84.0	2L	1900	0.4										
									4	80.0	4L	2000	0.4										
08-02	038TDX*43A4	P	3.0	0	19086	69	29.39	50	1	90.0	2L	1850	1.0	P				N	92.0	92.0	N		
									2	90.0	2U	1800	1.0										
									4	88.0	2L	1850	1.0										
									1	89.0	2L	1850	1.0										
									2	89.0	2U	1800	1.0										
									4	87.0	2L	1800	1.0										
08-03	038TDX*43A4	P	3.0	0	19097	48	29.07	84	1	87.0	4L	1400	1.0	87.0	2L	2200	1.0						
									2	86.0	2L	4000	0.0										
									4	86.0	4L	1600	1.0										
									1	86.0	4L	1400	1.0										
									2														
									4														
08-04	038TDX*43A4	P	3.0	0	6000	42	29.45	00	1	86.0	2L	2000	1.0	84.0	2L	1600	0.0						
									2	86.0	2L	2000	1.0										
									4	86.0	4L	1600	1.0										
									1	86.0	2L	2000	1.0										
									2														
									4														
08-05	038TDX*43A4	P	3.0	0	22425	67	29.00	49	1	90.0	2U	2400	0.6	88.0	4L	1850	0.0						
									2	91.0	2L	2400	0.6										
									4	87.0	2L	2400	0.6										
									1	90.0	2L	2400	0.6										
									2														
									4														
08-06	038TDX*43A4	C	3.0	0	14300	70	29.86	50	1	88.0	2U	2300	0.0	L				N	94.0	94.0	N		
									2	86.0	2U	2400	0.0										
									4	82.0	2U	2200	0.0										
									1	88.0	2L	2200	0.0										
									2	84.0	2L	2100	0.0										
									4	81.0	2L	2000	0.0										

1988 CRC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION								WEATHER			OCTANE NUMBER REQUIREMENT DATA									TANK FUEL INFORMATION							
													MAXIMUM				PART-THROTTLE							RATER				
					SPARK ADVANCE																							
TEST NO	MODEL CODE	EMIS T	TRANS	C.I.D.	A/R	BAS POD	BAS TST	ODOM MILES	AMB TMP	BAROM	HUM	FUEL	OCT NO	GEAR	RPM	VAC	OCT NO	GEAR	RPM	VAC	OWNER K	OCT NO RES	OCT NO MOTR	KNOCK	GEAR	RPM	VAC	
0TAK7	005T00xT4044	F	4	3.0	[illegible]	+0	+0	10305	63	30.01	43	0	85.0	3U	2400	0.0	F				N			N				
			-									2	87.0	2U	0800	0.0												
			-									4	85.0	3U	0500	0.0												
			-									0																
			-									2																
			-									4																
[illegible]	006LK0xT8T44	F	-	3.1	+	+0	+0	06881	38	29.04	04	0	90.0	3U	2100	1.0	90.0	3U	1900	4.0								
			-									2	91.0	3U	2000	1.0												
			-									4	91.0	3U	2100	1.0												
			-									0	90.0	3U	2100	1.0	90.0	3U	1900	4.0								
			-									2																
			-									4																
[illegible]	P06KK0xT8T44	F	-	3.1		+0	+0	3331	66	30.05	64	0	84.0	3U	2100	1.0	91.0	3U	2400	0.0								
			-									2	84.0	3U	2000	1.0												
			-									4	81.0	3U	2000	1.0												
			-									0	84.0	3U	2100	1.0												
			-									2																
			-									4																
[illegible]	P06KK0xT8T44	F	-	3.1	+	+0	+0	6135	66	30.10	00	0	84.0	3U	2000	0.8	88.0	4U	1500	0.8	N							
			-									2	85.0	3U	1900	0.8												
			-									4	84.0	3U	2100	0.8												
			-									0	90.0	3U	2150	0.8												
			-									2	91.0	3U	1950	0.8												
			-									4	92.0	3U	1900	0.8												
[illegible]	P06KK0xT8T44	0	-	3.1	+	+0	+0	6400	70	29.88	50	0	88.0	3U	2400	1.0	F				N	94.0	84.0	N				
			-									2	94.0	3U	2500	1.0												
			-									4	91.0	3U	2250	1.0												
			-									0	92.0	3U	2400	1.0												
			-									0	93.0	3U	2500	1.0												
			-									4																
[illegible]104	P06KK2xT8T44	F	-	3.1	+	+0	+0	17191	63	30.03	79	0	88.0	4U	1000	0.0	88.0	4U	1900	1.0								
			-									2	89.0	3U	1900	0.0												
			-									4	90.5	3U	2000	0.0	89.0	3U	2100	0.0								
			-									0	87.5	4U	1400	0.0	87.0	4U	1400	1.0								
			-									2	88.0	3U	2000	0.0												
			-									4	90.5	3U	2000	0.0												

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

	VEHICLE DESCRIPTION											WEATHER				OCTANE NUMBER REQUIREMENT DATA										TANK FUEL INFORMATION									
																MAXIMUM					PART-THROTTLE													
			E		SPARK ADVANCE						F						G					G													
			M		A						U						E					E													
OBS.	MODEL		C	%	T	AS	AS	ODOM	AMB		E	OCT	A			OCT	A				OCT	A					%	OCT	NO	%	T	E			
NO.	CODE		T	S	O.R.	P	PCD	TST	MILES	TMP	BAROM	H.M	L	NO	P	RPM	LAC		NO	P	RPM	LAC					S	PBS	MOTR	T	P	P	RPM	LAC	
47407	ST1MX3X*P0144		C	N	8.5	+	+10	+11	8800	70	28.37	33	0	88.0	4	1800	0.4		88.0	4	1800	1.4													
													2	88.0	4	2000	0.4																	
													4	87.0	4	1800	0.4																	
47410	PT2X*2X*222M5		F	N	8.5	+			8838	69	30.02	59	0	90.0	4	2050	1.0		F								N			N					
													2	90.0	4	2050	1.0																	
													4	88.0	4	2100	1.0																	
47416	PT8-N2X*T24M5		F	N	8.0	+			8861	70	28.67	71	0	87.0	B	2500	0.8		85.0	B	2400	8.0								N					
													2	87.0	B	2400	0.8		86.0	B	2300	8.0													
													4																						
47417	ST6I-2X*T214A		F	N	8.0				8726	70	28.60	75	0	82.0	DL	2000	0.8		80.0	DL	2000	8.0								N					
													2	84.0	DL	2250	1.0																	
													4																						
47417	284A-2X*P2144		F	N	8.5	+			16273	70	28.66	75	0	87.0	DL	1800	1.4		84.0	DL	2000	1.8								N					
													2	86.0	DL	2400	1.2		86.0	DL	2200	1.8													
													4																						
47419	P3X1P2X*224M4		E	-	8.0	+	0	+ 0	8868	70	28.42	0	0						80.0	4	1950	1.7	N	81.0	80.0	N									
				-									2						88.0	4	2050	1.7													
				-									4						80.0	4	1900	1.9													
				-									0		0				88.0	4	1950	1.7													
				-									2		0				88.0	4	2050	1.7													
				-									4		0				80.0	4	1900	1.7													
47426	P1X1P2X*224M5		F	-	8.0	+			7840	46	28.60	57	0	87.0	4	1700	1.6		F								N	84.0	80.0	N					
				-									2	87.0	4	1750	0.6																	
				-									4	86.0	4	1600	1.6																	
				-									0	86.0	4	1800	0.6		F															
				-									2	87.0	4	1800	1.6																	
				-									4	84.0	4	1850	1.6																	
47428	P44IP2X*P24M5		F	-	8.0	+	+ 5	+ 5	8100	67	30.20	46	0	85.0	4	1800	1.6		F								N	85.6	86.1	B	M	4	2050		1.6
				-									2	86.0	4	2000	1.6																	
				-									4	86.0	4	1800	1.6																	
				-									0																						
				-									2																						
				-									4																						

1989 CRC OCTANE NUMBER REQUIREMENT SURVEY

VEHICLE DESCRIPTION												WEATHER		OCTANE NUMBER REQUIREMENT DATA								TANK FUEL INFORMATION					
					SPARK ADVANCE									MAXIMUM				PART-THROTTLE						RATED			
DESIG. NO.	MODEL CODE	ENGINE TYPE	CYL.	DISP.	MAN. TRANS.	AUTO. TRANS.	AUTO. TRANS.	ODOM. MILES	EMS TMP	BAROM	HUM	FUEL TANK	OCTANE NO.	RVP	PPM	ADJ.	OCTANE NO.	RVP	PPM	ADJ.	OCTANE NO.	RVP	MOTOR	ADJ.	RVP	PPM	ADJ.
47 10	P94(P0*P01MB	0	4	3.0	+ 5	+5	9103	74	30.06	85	0	90.0	0	0000	0.0					N	90.4	+ M	4	0700	0.0
		-									2	94.0	0	1700	0.0										
		-									4	94.0	0	1700	0.0										
		-									0	92.0	0	0500	0.0										
		-									2	92.0	0	800	0.0										
		-									4	92.0	0	1600	0.0										
47 10	P94(P0*P01MB	0	4	3.0	+ 5	+ 5	9103	70	29.33	80	0	94.0	4	0000	0.0	92.5	4	1600	0.0							
		-									2	94.0	4	0000	0.0										
		-									4	94.0	4	0000	0.0										
		-									0	92.0	4	0000	0.0										
		-									2															
		-									4															

A P P E N D I X F

PROCEDURES FOR CALCULATING AND PLOTTING OCTANE NUMBER REQUIREMENT DISTRIBUTION DATA

WEIGHTED VEHICLE POPULATIONS

Weighting factors for each model tested were proportioned to the productions and/or sales volumes developed from information supplied by U.S. vehicle manufacturers and from published information (Ward's Automotive Reports) for imports. The weighting factors of each vehicle model were divided by the number of vehicles tested within the model to calculate the individual vehicle weighting factor. The octane requirement for each vehicle were then arranged in increasing order. The percent of vehicles at each octane level is the summation of all vehicle weighting factors with octane requirements lower than that level, plus one-half the sum of the weighting factors at that level. The individual vehicle weighting factors are adjusted so that the summation of all vehicle weighting factors within the population of interest equals 100. Vehicle weighting factors for vehicles with octane requirements lower (L) than the lowest available fuel are assigned to beginning of the distribution while weighting factors for vehicles with octane requirements higher (H) than the highest test fuel are assigned above the highest test fuel octane level. For L and H octane requirements no octane value is used in the computation of octane satisfaction.

Octane satisfaction at population distribution points of interest is interpolated from the above distributions based on numeric octane data and an assumption of normal distribution between the two interpolation points.

DATA ROUND-OFF

The octane number requirements were rounded by the computer to one decimal place. All computations leading to the final rounded values were carried out at the full precision of the computer. In previous surveys the computer rounded requirement data to two decimal places. In preparing report tables the Analysis Panel rounded the computer decimal requirements to one decimal place.

In order to provide consistent treatment comparing 1988 and 1987 survey data, the 1987 data were recomputed and rounded to one decimal place by the computer. This can result in occasional small differences (e.g. $\pm$ 0.1) if a comparison is made using the data in the 1987 survey report.

SELECT CAR MODELS

For individual models, the octane number requirement distribution curves were plotted by the "Z" method as described in "Statistical Estimation of the Gasoline Octane Number Requirement of New Model Automobiles," C. S. Brinegar and R. R. Miller, Technometrics, Vol. 2, No. 1, February 1960.

The procedure is as follows:

For any vehicles having octane requirements lower (L) than the lowest octane number fuel available within a given fuel level, a number 0.5 Research/0.4 Motor lower was assigned. Similarly, for individual vehicles having octane requirements higher (H) than the highest octane fuel available within a given fuel series, a number 0.5 Research/0.4 Motor higher was assigned.

Using all observed and estimated octane number values, calculate the mean (X) and the standard deviation (s) from the data for each model.

$$s = \left[\frac{1}{n-1} \sum_{i=1}^{n} (X - \bar{X})^2 \right]^{1/2}$$

Where X_i = Octane number requirement of i^{th} car of a given model

n = Number of cars of that model.

Estimate octane number requirements at the percentiles of interest from octane number requirement distribution data by

$$O.N. = \bar{X} + ks$$

Where k is selected from normal distribution tables.

Values of k used to calculate percentiles in this report are:

Percentile	k
5	-1.645
10	-1.282
20	-0.842
30	-0.524
40	-0.253
50	0
60	+0.253
70	+0.524
80	+0.842
90	+1.282
95	+1.645

A P P E N D I X G

CONFIDENCE LIMITS OF
OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

CONFIDENCE LIMITS OF OCTANE NUMBER REQUIREMENT DISTRIBUTIONS

Octane number requirements of vehicles presented in this Survey are determined at the levels that satisfy certain percentages of specific vehicle populations. In many cases, the recorded octane number requirement is followed by a plus and minus limit, referred to as the confidence interval. These limits are expected to bound the true requirement of the population represented by the test vehicles 95 percent of the time in replicate testing of the same number of test vehicles.

At the 50 percent satisfaction level, the 95 percent confidence interval is calculated as follows:

$$CI = \pm ts/(n)^{1/2}$$

where t = Students t at the proper number of degrees of freedom*

s = Standard deviation, calculated directly from the data or estimated as the difference between the 84.16th and 50th percentiles (assuming normal distribution)

n = Number of vehicles in population.

At other satisfaction levels:

$$CI = \pm ts \left[1/n + k^2/[2(n-1)]\right]^{1/2}$$

At the 90 percent satisfaction level, k = 1.2817. For other satisfaction levels, appropriate values for k may be found in the standard statistical tables.

Degrees of Freedom**	t	Degrees of Freedom**	t
1	12.706	18	2.101
2	4.393	19	2.093
3	3.182	20	2.086
4	2.776	21	2.080
5	2.571	22	2.074
6	2.447	23	2.069
7	2.365	24	2.064
8	2.306	25	2.060
9	2.262	26	2.056
10	2.228	27	2.052
11	2.201	28	2.048
12	2.179	29	2.045
13	2.160	30	2.042
14	2.145	40	2.021
15	2.131	60	2.000
16	2.120	120	1.980
17	2.110	∞	1.960

* Distribution of t for probability = 0.05.

** Degrees of Freedom = (n-1).

TABLE G-1

95% CONFIDENCE LIMITS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS

1988 Weighted Population Groups

Population	Fuel	No. Veh.	t	Standard Dev. RON	Standard Dev. MON	Standard Dev. (R+M)/2	95% Confidence Limits RON 50%	RON 90%	MON 50%	MON 90%	(R+M)/2 50%	(R+M)/2 90%
Total Vehicles												
Includes Knock Sensor Maximum (High-Borderline) Requirements	PR	372	1.966	3.75	3.75	3.75	0.38	0.52	0.38	0.52	0.38	0.52
	FBRU	391	1.966	3.93	2.55	3.24	0.39	0.53	0.25	0.34	0.32	0.43
	FBRSU	391	1.966	4.06	2.66	3.36	0.40	0.55	0.26	0.36	0.33	0.45
Includes Knock Sensor Minimum (Low-Borderline) Requirements	PR	308	1.968	3.60	3.60	3.60	0.40	0.55	0.40	0.55	0.40	0.55
	FBRU	375	1.966	3.60	2.35	2.97	0.37	0.49	0.24	0.32	0.30	0.40
	FBRSU	326	1.967	3.80	2.46	3.13	0.41	0.56	0.27	0.36	0.34	0.46
Total Cars												
Includes Knock Sensor Maximum (High-Borderline) Requirements	PR	298	1.968	3.53	3.53	3.53	0.40	0.54	0.40	0.54	0.40	0.54
	FBRU	313	1.968	4.08	2.64	3.36	0.45	0.61	0.29	0.40	0.37	0.50
	FBRSU	313	1.968	4.39	2.88	3.63	0.49	0.66	0.32	0.43	0.40	0.54
Includes Knock Sensor Minimum (Low-Borderline) Requirements	PR	254	1.969	3.44	3.44	3.44	0.43	0.57	0.43	0.57	0.43	0.57
	FBRU	302	1.968	3.78	2.46	3.12	0.43	0.58	0.28	0.38	0.35	0.48
	FBRSU	267	1.969	4.22	2.76	3.49	0.51	0.69	0.33	0.45	0.42	0.57
Total Trucks												
Includes Knock Sensor Maximum (High-Borderline) Requirements	PR	74	1.992	3.51	3.51	3.51	0.81	1.10	0.81	1.10	0.81	1.10
	FBRU	78	1.990	3.43	2.25	2.84	0.77	1.05	0.51	0.69	0.64	0.87
	FBRSU	78	1.990	3.52	2.34	2.93	0.79	1.07	0.53	0.71	0.66	0.89
Includes Knock Sensor Minimum (Low-Borderline) Requirements	PR	54	2.004	3.16	3.16	3.16	0.86	1.17	0.86	1.17	0.86	1.17
	FBRU	73	1.992	3.22	2.13	2.67	0.75	1.02	0.50	0.67	0.63	0.84
	FBRSU	59	2.000	2.95	1.89	2.42	0.77	1.04	0.49	0.67	0.63	0.85

TABLE G-1
(Continued)

95% CONFIDENCE LIMITS FOR MAXIMUM OCTANE NUMBER REQUIREMENTS

1989 Weighted Population Groups

Population	Fuel	No. Veh.	t	Standard Dev. RON	Standard Dev. MON	Standard Dev. (R+M)/2	95% Confidence Limits RON 50%	RON 90%	MON 50%	MON 90%	(R+M)/2 50%	(R+M)/2 90%
Total Knock-Sensor Vehicles												
Includes Knock Sensor Maximum (High-Borderline) Requirements	PR	171	1.974	4.42	4.42	4.42	0.67	0.90	0.67	0.90	0.67	0.90
	FBRU	179	1.973	4.30	2.77	3.53	0.63	0.86	0.41	0.55	0.52	0.70
	FBRSU	179	1.973	3.98	2.64	3.31	0.59	0.79	0.39	0.53	0.49	0.66
Includes Knock Sensor Minimum (Low-Borderline) Requirements	PR	107	1.981	3.93	3.93	3.93	0.75	1.02	0.75	1.02	0.75	1.02
	FBRU	163	1.975	3.71	2.42	3.06	0.57	0.78	0.37	0.51	0.47	0.64
	FBRSU	114	1.980	3.55	2.29	2.92	0.66	0.89	0.42	0.57	0.54	0.73

TABLE G-2

95% CONFIDENCE LIMITS FOR MAXIMUM (R+M)/2, RON, AND MON REQUIREMENTS

1989 Select Models

Model	Fuel	n	t	Std. Dev. (s) (R+M)/2	95% Confidence Limits, (R+M)/2 50% Satis.	95% Confidence Limits, (R+M)/2 90% Satis.	Std. Dev. (s) RON	95% Confidence Limits, RON 50% Satis.	95% Confidence Limits, RON 90% Satis.	Std. Dev. (s) MON	95% Confidence Limits, MON 50% Satis.	95% Confidence Limits, MON 90% Satis.
C21BU2*P30AF	PR	10	2.26	3.2	2.3	3.2	3.2	2.3	3.2	3.2	2.3	3.2
(High Borderline)	FBRU	10	2.26	2.3	1.6	2.3	2.8	2.0	2.8	1.8	1.3	1.8
	FBRSU	10	2.26	2.0	1.4	2.0	2.4	1.7	2.4	1.6	1.2	1.6
C21BC2*P30A44	PR	8	2.36	3.4	2.9	4.0	3.4	2.9	4.0	3.4	2.9	4.0
(Low Borderline)	FBRU	10	2.26	2.1	1.5	2.1	2.6	1.9	2.6	1.7	1.2	1.7
	FBRSU	8	2.36	2.0	1.7	2.4	2.4	2.0	2.8	1.6	1.4	1.9
C22RC3*P22A4	PR	10	2.26	3.0	2.2	3.0	3.0	2.2	3.0	3.0	2.2	3.0
	FBRU	11	2.23	3.2	2.1	2.9	3.8	2.6	3.6	2.5	1.7	2.3
	FBRSU	11	2.23	3.1	2.1	2.9	3.8	2.5	3.5	2.5	1.7	2.3
C21042*P38A4/	PR	23	2.07	2.8	1.2	1.7	2.8	1.2	1.7	2.8	1.2	1.7
C21S42*P38A4/	FBRU	23	2.07	2.2	0.9	1.3	2.6	1.1	1.5	1.7	0.7	1.0
C22S42*P38A4	FBRSU	23	2.07	2.4	1.0	1.4	2.8	1.2	1.7	1.9	0.8	1.1
C21PF2*P50A4/C22PF2*P50A4/	PR	10	2.26	2.8	2.0	2.8	2.8	2.0	2.8	2.8	2.0	2.8
C24PF2*P50A4	FBRU	10	2.26	3.0	2.1	2.9	3.6	2.6	3.5	2.4	1.7	2.3
	FBRSU	10	2.26	3.2	2.3	3.2	3.8	2.7	3.7	2.6	1.9	2.6
C31AR2*T25A3/C32AR2*T25A3/	PR	11	2.23	2.5	1.7	2.3	2.5	1.7	2.3	2.5	1.7	2.3
C33AR2*T25A3	FBRU	11	2.23	2.9	1.9	2.7	3.5	2.3	3.2	2.3	1.5	2.1
C34AR2*T25A3/C34NR2*T25A3	FBRSU	11	2.23	3.1	2.1	2.8	3.6	2.4	3.4	2.5	1.7	2.3
C31AW2*P28A4/C32AW2*P28AA/	PR	23	2.07	2.8	1.2	1.6	2.8	1.2	1.6	2.8	1.2	1.6
C33AW2*P28AA/C33AW2*P28AA/	FBRU	23	2.07	3.0	1.3	1.8	4.7	1.6	2.2	2.4	1.0	1.4
C34AW2*P28AA/C34AW2*P28AA	FBRSU	23	2.07	3.0	1.3	1.8	4.6	1.4	2.3	2.5	1.1	1.5

TABLE G-2
(Continued)

95% CONFIDENCE LIMITS FOR MAXIMUM (R+M)/2, RON, AND MON REQUIREMENTS

1989 Select Models

Model	Fuel	n	t	Std. Dev. (s) (R+M)/2	95% Confidence Limits, (R+M)/2 50% Satis.	95% Confidence Limits, (R+M)/2 90% Satis.	Std. Dev. (s) RON	95% Confidence Limits, RON 50% Satis.	95% Confidence Limits, RON 90% Satis.	Std. Dev. (s) MON	95% Confidence Limits, MON 50% Satis.	95% Confidence Limits, MON 90% Satis.
C31J12*T20A3/C31L12*T20A3	PR	10	2.26	4.1	2.9	4.0	4.1	2.9	4.1	4.1	2.9	4.1
	FBRU	11	2.23	3.8	2.5	3.5	4.6	3.1	4.2	3.0	2.0	2.8
	FBRSU	11	2.23	4.3	2.9	3.9	5.0	3.4	4.6	3.5	2.4	3.2
C32ND4*P2A3/C33ND4*P23A3/ C34ND*P23A3 (High Borderline)	PR	12	2.20	6.1	3.9	5.4	6.1	3.9	5.4	6.1	3.9	5.4
	FBRU	12	2.20	4.4	2.8	3.9	5.3	3.4	4.6	3.6	2.3	3.1
	FBRSU	12	2.20	5.2	3.3	4.5	6.1	3.9	5.4	4.2	2.7	3.7
C32ND4*P23A3/C33ND4*P23A3/ C34ND4*P23A3 (Low Borderline)	PR	9	2.31	5.2	4.0	5.6	5.2	4.0	5.6	5.2	4.0	5.6
	FBRU	11	2.23	3.6	2.4	3.3	4.2	2.9	3.9	2.9	1.9	2.7
	FBRSU	9	2.31	4.1	3.1	4.3	4.9	3.7	5.2	3.3	2.5	3.5
C32WT2*P31A4/C33WT2*P31A4/ C34WT2*P31A4 (High Borderline)	PR	11	2.23	3.6	2.4	3.3	3.6	2.4	3.3	3.6	2.4	3.3
	FBRU	11	2.23	3.7	2.5	3.4	4.5	3.0	4.2	2.9	2.0	2.7
	FBRSU	11	2.23	4.1	2.7	3.8	4.8	3.2	4.4	3.4	2.3	3.1
C32WT2*P31A4/C33WT2*P31A4/ C34WT2*P31A4 (Low Borderline)	PR	9	2.31	4.5	3.5	4.8	4.5	3.5	4.8	4.5	3.5	4.8
	FBRU	11	2.23	3.8	2.6	3.5	4.6	3.1	4.3	3.0	2.0	2.8
	FBRSU	9	2.31	3.5	2.7	3.7	4.2	3.2	4.4	2.8	2.2	3.0
C33AN2*P33A4/C34AN2*P33A4 (High Borderline)	PR	11	2.23	3.4	2.3	3.1	3.4	2.3	3.1	3.4	2.3	3.1
	FBRU	12	2.20	3.6	2.3	3.2	4.4	2.8	3.8	2.9	1.8	2.5
	FBRSU	12	2.20	4.0	2.6	3.5	4.8	3.0	4.2	3.3	2.1	2.9
C33AN2*P33A4/C34AN2*P33A4 (Low Borderline)	PR	6	2.57	2.1	2.2	3.2	2.1	2.2	3.2	2.1	2.2	3.2
	FBRU	11	2.23	3.9	2.6	3.6	4.7	3.2	4.3	3.1	2.1	2.8
	FBRSU	7	2.45	2.9	2.7	3.7	3.5	3.2	4.5	2.3	2.1	3.0
C34HC2*P33A4/C34LC2*P33A4/ C34HC2*P33A4 C34HC2*P33A4/ C34LC2*P33A4	PR	15	2.14	5.3	2.9	4.0	5.3	2.9	4.0	5.3	2.9	4.0
	FBRU	15	2.14	4.1	2.3	3.1	4.9	2.7	3.7	3.3	1.8	2.5
	FBRSU	15	2.14	4.7	2.7	3.6	5.4	3.1	4.5	4.0	2.2	3.0

TABLE G-2
(Continued)

95% CONFIDENCE LIMITS FOR MAXIMUM (R+M)/2, RON, AND MON REQUIREMENTS

1989 Select Models

Model	Fuel	n	t	Std.Dev. (s) (R+M)/2	95% Confidence Limits, (R+M)/2 50% Satis.	95% Confidence Limits, (R+M)/2 90% Satis.	Std.Dev. (s) RON	95% Confidence Limits, RON 50% Satis.	95% Confidence Limits, RON 90% Satis.	Std.Dev. (s) MON	95% Confidence Limits, MON 50% Satis.	95% Confidence Limits, MON 90% Satis.
S15XL2*P40A4	PR	8	2.36	6.1	5.1	7.1	6.1	5.1	7.1	6.1	5.1	7.1
(Low Borderline)	FBRU	10	2.26	4.8	3.4	4.7	5.7	4.1	5.6	3.9	2.8	3.8
	FBRSU	8	2.36	3.3	2.8	3.9	4.0	3.3	4.6	2.7	2.2	3.1
S36RK2*T57A4/V36GK2*T57A4/	PR	11	2.23	2.6	1.8	2.4	2.6	1.8	2.4	2.6	1.8	2.4
P36CK2*T57A4 S36UK2*T57A4/	FBRU	11	2.23	2.3	1.6	2.2	2.8	1.9	2.6	1.8	1.2	1.7
P36KK2*T57A4	FBRSU	11	2.23	2.4	1.6	2.2	2.9	1.9	2.6	1.9	1.3	1.8
(High Borderline)												
S36RK2*T57A4/V36GK2*T57A4/	PR	3	4.39	3.1	7.9	11.8	3.1	7.9	11.8	3.1	7.9	11.8
P36CK2*T57A4 S36UK2*T57A4/	FBRU	10	2.26	2.2	1.6	2.2	2.7	1.9	2.6	1.7	1.2	1.7
P36KK2*T57A4	FBRSU	5	2.78	2.2	2.7	3.8	2.6	3.2	4.6	1.7	2.1	3.0
(Low Borderline)												
C31AW2*P28A4/C32AW2*P28A4/	PR	14	2.16	2.9	1.7	2.3	2.9	1.7	2.3	2.9	1.7	2.3
C32WW2*P28A4 C33AW2*P28A4/	FBRU	21	2.09	2.4	1.6	2.1	4.2	1.9	2.6	2.7	1.2	1.7
C34WW2*P28A4	FBRSU	14	2.16	3.4	2.0	2.7	4.1	2.4	3.2	2.7	1.6	2.2
(Low Borderline)												
C32HC2*P38A4/C33EC2*P38A4/	PR	9	2.31	4.8	3.7	5.1	4.8	3.7	5.1	4.8	3.7	5.1
C33HC2*P38A4 C34HC2*P38A4/	FBRU	14	2.16	3.9	2.2	3.1	4.6	2.7	3.7	3.1	1.8	2.5
C34CC2*P38A4	FBRSU	9	2.31	4.8	3.7	5.1	5.8	4.4	6.1	3.9	3.0	4.1
(Low Borderline)												
S15XL2*P40A4	PR	8	2.31	5.9	4.6	6.3	5.9	4.6	6.3	5.9	4.6	6.3
(High Borderline)	FBRU	10	2.26	4.8	3.4	4.7	5.7	4.1	5.6	3.9	2.8	3.8
	FBRSU	10	2.26	4.5	3.2	4.4	5.3	3.8	5.2	3.7	2.6	3.6